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VOL. CXXXVIII.—No. 3578] LONDON: FRIDAY EVENING, JULY 25, 1924 [PRICE {WITH INDEX AND OTHER SUPPLEMENT} 1s. 6D. BY INLAND POST 1s. 9d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:

1. WHEELS AND AXLES.
2. MILD STEEL SLUICE GATES, 60ft. by 16ft., with GEAR.

Tenders due on the 6th August, 1924, for No. 1, and on the 15th August, 1924, for No. 2.
Tender forms obtainable from above. 6464

Scientific Assistant REQUIRED for Metallurgical Research in an Admiralty Establishment from August. Salary scale £250 by increments of £20 annually to £450, plus Civil Service bonus (which varies with the cost of living and at present amounts to £127 on £250), and benefits under the Federated Universities Superannuation Scheme. Candidates must possess an honours degree or its equivalent and have had research experience.—Replies should be forwarded to the SECRETARY of the ADMIRALTY (C.E.), Whitehall, London, S.W.1, not later than 15th August. 6476

University of Birmingham.

FACULTY OF SCIENCE.

ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.
Chance Professor: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M. Inst. C.E., M. Inst. M.E.
Lecturer: R. C. PORTER, M.Sc. (Vict.), A.M. Inst. C.E.
Demonstrator: S. J. ELLIS, B.Sc., A.M.I.C.E.
Lecturer on Machine Design: F. H. BODEN, B.Sc.
Assistant Lecturer on Machine Design: H. P. DEAN, B.Sc.

II.—CIVIL ENGINEERING.
Beale Professor: CYRIL BATHO, D.Sc., B.Eng.
Lecturers: R. C. PANTON, M.Sc.
H. W. COULTAS, M.Sc.
T. H. P. VEAL, B.Sc.
Lecturer on Town Planning: W. HAYWOOD.

III.—ELECTRICAL ENGINEERING.
Professor: WILLIAM CRAMP, D.Sc.
Lecturer: E. J. KIPPS, M.Sc., M. Inst. E.E.
Assistant Lecturers and Demonstrators: O. E. RANDALL, M.Sc.
G. M. HARVEY, M.Sc., B.Eng.

THE FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED to the DEGREE of BACHELOR OF SCIENCE in Engineering.
THE SESSION 1924-25 COMMENCES on OCTOBER 6th, 1924.
For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 6452

Newcastle-upon-Tyne Education COMMITTEE.
RUTHERFORD TECHNICAL COLLEGE.
Principal: C. L. ECLAIR-HEATH, Wh.Sc., A.M.I.M.E.

APPLICATIONS are INVITED for APPOINTMENT of a LECTURER in MECHANICAL ENGINEERING. Applicants should have had a good technical and scientific education in a University or Technical College, have obtained a degree or its equivalent, and have had good drawing-office and works experience. It is desirable that candidates should have experience in the design and manufacture of internal combustion engines (including Diesel), and possess a good knowledge of hydraulics.
Salary according to Burnham Technical Scale, less 5 per cent.
Applications (on form to be obtained by sending stamped addressed foolscap envelope) to be returned to the undersigned not later than Tuesday, 19th August, 1924.

THOS. WALLING,
Director of Education.
Education Office, Northumberland-road. 6467

University College of Swansea.

APPLICATIONS are INVITED for the POST of LECTURER in CIVIL ENGINEERING. Salary £500 per annum. The appointment will date from October 1st, 1924.
Further particulars may be obtained from the undersigned, by whom applications must be received on or before August 23rd, 1924.

EDWIN DREW,
Registrar.
Singleton Park, Swansea. 6468

Corporation of Dublin.

TENDERS are hereby INVITED for TWO ELECTRICALLY DRIVEN AIR COMPRESSORS with about 120 YARDS of 8in. CAST IRON AIR MAIN and necessary VALVES. The Compressors are to deliver 4000 cubic feet of air per minute against a pressure of 10 lb. to the square inch. Specification and drawing accompanying same can be obtained on and after 21st July, 1924, at the office of the City Treasurer, Exchange Buildings, Lord Edward-street, upon the deposit of Two Guineas.
The deposit will be refunded on the return of the original documents, and the receipt of a bona fide Tender.
Tenders, sealed and endorsed on the envelope "Tender for Air Compressors, Main Drainage," are to be addressed to Commissioners of the County Borough of Dublin, City Hall, and are to be delivered not later than Twelve Noon on the 19th August, 1924.

By Order,
JOHN J. MURPHY,
Town Clerk.
17th July, 1924. 6456

Public Tenders.—Corporations and other PUBLIC BODIES are INVITED, before issuing final invitations for Tenders, to COMMUNICATE with GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION. The Corporation has available for Disposal large quantities of Plant, Machinery and Materials in good condition arising at and arising from Government Factories and Works, the employment of which may, if their lists are consulted in the first place, effect great economies.—GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, S.W. 1. 6329

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Overhead Ropeway for an Explosives Factory (With a Two-Page Supplement).

The British Empire Exhibition (Fourteenth Notice).

British Wire-Drawing and Wire-Working Machinery—No. II.

World Power Conference (Fourth Notice).

100 Years of British Railways—No. IV.

Standardised Light Cruisers.

Railway Wagon Body Making Machine.

The Future of Technical Institutions.

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PUBLIC NOTICES

Borough of Portsmouth.
MAIN DRAINAGE.—CONTRACT NO. 9.
TO CONTRACTORS.

The Corporation of Portsmouth is prepared to receive TENDERS for the CONSTRUCTION of REINFORCED CONCRETE DUCT, SUCTION CHAMBER, EXCAVATION for and LAYING of CAST IRON PIPES, LAYING and JOINTING of various lengths of DRAINS, ALTERATIONS to FOUNDATIONS in an existing BEAM ENGINE-HOUSE, and other WORKS at their Eastney Sewage Pumping Station, in accordance with the drawings, general conditions and specification prepared by the Engineer, Mr. G. Midgley Taylor, of Messrs. John Taylor and Sons, 36, Victoria-street, Westminster, London, S.W. 1.
The specification, bill of quantities and form of Tender may be obtained from the office of the Engineer upon payment of £5 (cheque only), which will be returned upon receipt of a bona fide Tender.
The drawings may be inspected at the offices of the Engineer or at the office of the Borough Engineer, Town Hall, Portsmouth.
Sealed Tenders, endorsed "Main Drainage, Contract No. 9," addressed to the Town Clerk, are to be delivered at his office on or before 9 a.m. on Friday, the 5th day of September, 1924.
The Corporation does not bind itself to accept the lowest or any Tender.

F. J. SPARKS,
Town Clerk.
Town Clerk's Office,
The Town Hall, Portsmouth.
15th July, 1924. 6479

City of Birmingham.
TENDERS FOR PLANT FOR REFUSE DISPOSAL AND SALVAGE PLANT, TYSELEY.

The Salvage and Stables Committee invite TENDERS for the SUPPLY, DELIVERY and ERECTION of PLANT for REFUSE DISPOSAL and SALVAGE WORKS at Redfern-road, Tyseley, as follows:—
CONTRACT NO. 1.
Two 100 K.W. Steam-driven D.C. Generators complete with Condenser and Control Panels; High-tension 3-Phase Transformer, Rotary Converter and Control Panel; Distribution Panels and Fuse Boxes; One 3-Wire Balancer with Control Panel for lighting.
CONTRACT NO. 2.
Two Five-Wire Balancer Sets with Switchgear and Control Panels for Electric Vehicle Charging.
CONTRACT NO. 3.
One Paper Baling Press; Two Scrap Baling Presses; One Hydraulic Accumulator; One Intensifier; Two Sets of Electrically Driven Pumps.
The general conditions of contract (which include the Corporation's usual fair wages and conditions of labour clauses) may be seen, and copies of the specification and other particulars obtained, upon application to Mr. James Jackson, Superintendent, Salvage Department, 161, Corporation-street, Birmingham, on payment of a deposit of £1 1s., which will be refunded on receipt of a bona fide Tender.
Sealed Tenders, endorsed "Contract No. —," must be delivered at the offices of the Superintendent of the Salvage Department not later than Nine a.m., Saturday, August 30th.
The Committee do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right to divide each and any of the contracts and to contract with two or more contractors.
Contractors must state whether they have adopted the Government Scheme relating to the employment of disabled ex-Service men.

F. H. C. WILTSHIRE,
Town Clerk.
The Council House, Birmingham,
21st July, 1924. 6475

PUBLIC NOTICES

County Borough of Southampton.
ELECTRICAL PLANT.

The Corporation invite TENDERS for the SUPPLY, DELIVERY and ERECTION at their Electricity Works, Western Esplanade, of the following PLANT:
(a) TWO WATER-TUBE BOILERS, complete with SUPERHEATERS, CHAIN-GRATE STOKERS, ECONOMISERS, MOUNTINGS, &c.
(b) ONE SET of INDUCED DRAUGHT FANS and STEEL CHIMNEY, &c.
(c) STEAM FEED-WATER, and other PIPING, COVERING, &c.
Specifications may be obtained from the Borough Electrical Engineer at the Electricity Works, Western Esplanade, Southampton, upon production of the Borough Treasurer's receipt for a deposit of £2 2s. Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders. Additional copies of the specifications may be obtained upon payment (not returnable) of £1 1s. per copy.
Sealed Tenders, endorsed "Boiler House Plant," must be delivered at the Town Clerk's office by Twelve o'clock at Noon on Tuesday, the 26th August, 1924.
No pledge is given to accept the lowest or any Tender.

R. R. LINTHORNE,
Town Clerk.
18th July, 1924. 6457

Great Northern Railway (Ireland).
TO BRIDGE CONTRACTORS.

The Directors are prepared to receive TENDERS for the RECONSTRUCTION of a STEEL UNDERLINE BRIDGE between Newbliss and Clones.
The drawings and specification may be inspected at the Engineer's Offices, Dublin and Belfast, and copies of same, together with bills of quantities and forms of Tender, may be obtained from the undersigned on payment of Two Guineas, which will be refunded on receipt of a bona fide Tender and on return of the drawings.
Tenders, made out on the forms supplied by the Company, should be delivered under sealed cover, endorsed "Tender for Bridge," not later than 10 a.m. on Monday, 18th August, 1924.
The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS,
Secretary.
Amiens-street Station, Dublin,
22nd July, 1924. 6480

Tyne Improvement Commission.
TWIN-SCREW STEAM FERRY BOAT.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the CONSTRUCTION and DELIVERY in the Tyne of a TWIN-SCREW STEAM FERRY BOAT.
Copies of the form of Tender, conditions of contract, specification and outline drawings may be obtained on application to the undersigned on payment of a deposit of £2 2s., which will be returned on receipt of a bona fide Tender.
Tenders, in sealed envelopes, endorsed "Tender for a Twin-screw Steam Ferry Boat," must be delivered at the undermentioned offices, addressed "The Chairman, Harbour and Ferry Committee," not later than Noon on Monday, the 18th day of August, 1924.
The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.
Tyne Improvement Commission,
Bewick-street, Newcastle-upon-Tyne,
18th July, 1924. 6453

PUBLIC NOTICES

Southam Rural District Council.
WATERWORKS PUMPING MACHINERY.

The above Council invite TENDERS for the SUPPLY, ERECTION and FIXING of TWO VERTICAL TREBLE-RAM PUMPS of 6000 gallons per hour capacity at Southam, in Warwickshire.
Specification, schedule of prices and form of Tender may be obtained on application to the Engineers, Messrs. Taylor and Wallis, Commercial Union Buildings, 47, Pilgrim-street, Newcastle-on-Tyne, on payment of £5 deposit, which sum will be returned on receipt of a bona fide Tender and the documents lent to the contractor for the purpose of preparing his Tender.
Sealed Tenders, endorsed "Pumping Machinery," on the prescribed form, with the schedule of prices properly filled in, must be delivered to me, the undersigned, at my office not later than Saturday, 16th August, 1924.
The Council do not bind themselves to accept the lowest or any Tender.

CHARLES W. E. WEBB,
Clerk to Urban District Council.
Council Offices,
Southam, Warwickshire,
July, 1924. 6485

The Bengal-Nagpur Railway COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for:—
WROUGHT IRON, STEEL AND OTHER FITTINGS FOR CABOOSE BRAKE VANS.
Specification and form of Tender can be obtained at the Company's Offices, 122, Gresham House, Old Broad-street, E.C. 2, on or after 21st July, 1924.
A fee of 20s. will be charged for the specification, which is not returnable.
Tenders must be submitted not later than Noon on Thursday, 7th August, 1924.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
6474 Secretary.

AQUEDUCT NO. 5.—HODDER SUPPLY.—FIRST INSTALMENT.

The Fylde Water Board are open to receive TENDERS for the following:—
AUTOMATIC VALVES.
SLUICE VALVES.
AIR VALVES.
Specification and quantities can be obtained from the undersigned.
Tenders to be received by the undersigned not later than August 5th, 1924.
The Board do not bind themselves to accept the lowest, whole of, or any Tender.

JOHN COOK,
Engineer.
Head Office,
Sefton-street, Blackpool,
19th July, 1924. 6473

The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.
The Directors are prepared to receive TENDERS for FITTINGS for CAST IRON SLEEPER POTs for 90 lb. B.H. RAILS (B.S. SECTION No. 90 B), comprising—
35,488 MILD STEEL TIE BARS,
70,976 WROUGHT IRON COTTERS and
70,976 WROUGHT IRON GIBS,
according to the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.
Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, August 19th, 1924, and marked "Tender for Sleeper Fittings."
The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices,
25, Buckingham Palace-road,
Westminster, S.W. 1.
22nd July, 1924. 6492

Lambeth Workhouse, Prince's- ROAD, KENNINGTON, LONDON,
Near Albert Embankment and Vauxhall Railway Station (Southern Railway).

This desirable FREEHOLD PROPERTY FOR DISPOSAL, 2 acres in extent, comprising substantial buildings containing approximately 51,260 super feet floor space and 923,249 cubic feet of buildings.
Frontages approximately:—
Prince's-road, 410ft.
Tyers-street, 200ft.
Vauxhall-street, 266ft.
Apply, CLERK to the GUARDIANS, Guardians' Offices, Brook-street, Kennington-road, S.E. 11, to whom all inquiries should be addressed. 6451

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PUBLIC NOTICES

The South Indian Railway Company, LIMITED,

are prepared to receive TENDERS for the SUPPLY of—
STEAM TRAVELLING CRANES, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked, "Tender for Steam Travelling Cranes," must be left with the undersigned not later than Twelve Noon on Friday, the 22nd August, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Consulting Engineers to the Company, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
23rd July, 1924. 6507

Tyne Improvement Commission.

TEN-TON OVERHEAD ELECTRIC TRAVELLING CRANE AT HOWDON YARD.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the DELIVERY and ERECTION of a TEN-TON OVERHEAD ELECTRIC TRAVELLING CRANE at their New Erecting Shop at Howdon-on-Tyne.

Specification and general conditions of contract may be inspected at the offices of the Architects, Messrs. Cackett and Burns Dick, FF.R.I.B.A., Pilgrim House, Pilgrim-street, Newcastle-upon-Tyne, and manufacturers desirous of tendering for the work should forward their names and addresses to them not later than 9th August, 1924, together with a deposit of £2 2s., which amount will be returned upon receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Overhead Electric Travelling Crane," must be addressed to the Chairman, Dredging and River Works Committee, and delivered at the undermentioned offices not later than Noon on 15th August, 1924.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices,
Bewick-street, Newcastle-upon-Tyne,
21st July, 1924. 6477

City of Birmingham Water DEPARTMENT.

DRAUGHTSMAN REQUIRED TEMPORARILY for work in connection with Reservoir with earthen embankment.

Must be thoroughly experienced in design of waterworks, pipe lines, valve houses, reinforced concrete, &c.

Salary Seven Guineas per week.

To reside at Ludlow.

Applications, endorsed "Draughtsman," stating age, experience, &c., with copies of two recent testimonials, should be sent to the SECRETARY, Water Department, Council House, Birmingham, on or before 30th July, 1924. 6443

SITUATIONS OPEN

ENGINEER FOR JAPAN.—APPLICANTS for this POST, recently advertised in this column, are THANKED for their APPLICATIONS and are informed that the POSITION is now FILLED.—ASSOCIATED BRITISH MACHINE TOOL MAKERS, Ltd. 6482 A

WANTED by Well-known Engineers in the North, WORKS MANAGER; knowledge of Gearing essential. State qualifications and salary required.—Address, 6370, The Engineer Office. 6370 A

WANTED for Large Tube Works, WORKS MANAGER. Must be an experienced man with good testimonials. State references and salary required.—Address, 6460, The Engineer Office. 6460 A

FIRST-CLASS CABLE JOINTERS, MECHANICAL and ELECTRICAL FITTERS REQUIRED for Newfoundland, to sail August and September. Eight months' work.—Address, stating age and full details of experience, 6483, The Engineer Office. 6483 A

REQUIRED AT ONCE, ENGINEER (Must be a Member of the Institution of Structural Engineers), for Designs, Working Drawings, Reinforced Concrete, with at least five years' practical experience, for China. Salary, 1st year, £750; 2nd year, £800; 3rd year, £950.—Apply, Messrs. ROBERTSON and MALCOLM, Ltd., 5, Bishopsgate, E.C. 6496 A

REQUIRED, for Large Water Main Laying Contract in London, a good ENGINEER AGENT, capable of taking charge of same. Must be thoroughly experienced and have had charge of large works of a similar nature for a good contractor.—Address application, giving experience, list of works carried out, and copies of testimonials and stating salary required, 6486, The Engineer Office. 6486 A

WORKS ENGINEER, Coventry District.—First-class MAN REQUIRED, to Supervise Design and Construction of Industrial Buildings, Lay-out of Plant and Machinery, and Running of Steam-electric Generating Plant, Electric Motors, and Power Transmission. Apply, letter only, giving full particulars of experience, age, salary required, and reference.—Address, 6481, The Engineer Office. 6481 A

WANTED, CHIEF ENGINEER and DRAUGHTSMAN for old-established Gas and Chemical Engineers in North of England. Must be good practical as well as theoretical engineer. Permanent position for good man. State age, salary, and full particulars.—Address, 6350, The Engineer Office. 6350 A

WANTED, ENGINE DESIGNER, Diesel and Semi-Diesel, with good knowledge of latest designs.—Address, stating experience, with references, 6497, The Engineer Office. 6497 A

WANTED, Experienced DRAUGHTSMAN (Structural) for Estimating Dept. Must be capable of preparing designs and used to estimating for Constructional Steel Work.—Reply, stating salary reqd., to THE SIDE BRIDGE AND ENGINEERING WORKS, Limited, Middlesbrough. 6487 A

WANTED for North Midlands, a First-class MECHANICAL and STRUCTURAL DRAUGHTSMAN, used to Cement Plant Machinery and Lay-outs.—Address, stating age, details of experience, and salary expected, 6466, The Engineer Office. 6466 A

WANTED, Good DRAUGHTSMAN, Used to Rolling Mills and Furnaces, and with a good knowledge of Machinery. Apply by letter, stating age, experience, and salary required.—Address, 6455, The Engineer Office. 6455 A

WANTED, STRUCTURAL STEEL WORK DRAUGHTSMAN, thoroughly experienced in designing for and preparing fully detailed shop drawings for Steel Bridge and Roof Work. State age, details of experience, and salary required.—Apply, FRANCIS MORTON and CO., Ltd., Engineers and Contractors, Hamilton Ironworks, Garston, Liverpool. 6459 A

ASSISTANT ENGINEER DRAUGHTSMAN REQUIRED for Railway on West Coast of South America; must be single, and have had sound Engineering Training with Drawing-office Experience. A few years' practical experience essential. Three years' contract; free passage out and home; free quarters provided. Salary to commence, £360 per annum.—Write, with full particulars, to "A. E. D.," c.o. Charles Barker and Sons, Ltd., 31, Budge-row, Cannon-street, London, E.C. 4. 6488 A

DRAUGHTSMEN, Commercial Chassis, TWO Good SENIORS, TWO good JUNIORS WANTED for old-established progressive company 30 miles from London. State age and salary required. Send copies of recent testimonials.—Address, 6462, The Engineer Office. 6462 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN, First-class Mechanical, REQUIRED to prepare drawings and specification for Triple expansion Steam Engines, Pumps and Boiler. Must have good experience in drawing-office of large firm makers of this class of plant or with engineering department of water undertaking. Appointment temporary. Salary £8 a week.

Apply, letter only, giving experience and qualifications, to SECRETARY, Rickmansworth and Uxbridge Valley Water Company, 42 Poultry, E.C. 2. P0366 A

DRAUGHTSMAN WANTED, a Second Charge Hand, Estimating Department; good experience in the design and calculations of Steel-framed Buildings for home and abroad. Salary £5 10s. weekly.—Address, "DESIGN," Wm. Porteous and Co., Glasgow. P0348 A

DRAUGHTSMAN WANTED for Liverpool; Knowledge of Compressor Design essential.—Address, 6349, The Engineer Office. 6349 A

DRAUGHTSMAN WANTED, Used to Marine Refrigerating Plant Arrangements and Machinery.—Address, 6471, The Engineer Office. 6471 A

DRAUGHTSMAN, with Good Experience in Stationary and Marine Semi-Diesel Engines; preference given to man having practical experience. State experience, age and salary required.—Address, 6498, The Engineer Office. 6498 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

HEAD DRAUGHTSMAN, by Firm Manufacturing High-grade Medium and Small Machine Tools. Preference given to applicant with experience in American precision machinery.—Address, 6465, The Engineer Office. 6465 A

PUMPING MACHINERY. — DRAUGHTSMAN WANTED, capable of designing and calculating. State experience, age, and salary required.—Address 6022, The Engineer Office. 6022 A

REQUIRED for a Large Engineering Works in the Eastern Midland District, IRONFOUNDRY FOREMAN, experienced in producing castings for high water and air pressures, steam cylinders and general work from small weights up to 15 tons. Must be a good organiser, accustomed to piecework and bonus systems of payment.—Address, stating age, experience, and wages required, 6472, The Engineer Office. 6472 A

SEVERAL DRAUGHTSMEN REQUIRED, Having first-class experience of Belt Conveyors. Preference given to those having structural experience.—Replies by letter only, stating experience in full detail and salary expected, to STOTHERT and PITT, Limited, Bath. 6428 A

SKILLED SENIOR DRAUGHTSMAN REQUIRED, used to A.C. Machines.—THE LANCASHIRE DYNAMO and MOTOR CO., Ltd., Manchester. 6463 A

STRUCTURAL ENGINEERS REQUIRE CHIEF DRAUGHTSMAN for their Estimating Department accustomed to control of staff and good organiser; must be well versed in modern design of Light Steel-framed Buildings. State experience, salary required.—Address, "STRUCTURAL," Wm. Porteous and Co., Advertising Agents, Glasgow. P0347 A

TOOL DRAUGHTSMAN REQUIRED IMMEDIATELY by firm in London district engaged upon high-class work to close limits; must have had experience on high-class Motor Car Work.—Address, stating age, full details of experience and salary required, 6494, The Engineer Office. 6494 A

FOREMAN REQUIRED to Take Charge of Night-shift; must have had similar experience in a General Machine Shop, and be used to producing work in quantities to close limits.—Address, stating age, experience and salary required, 6495, The Engineer Office. 6495 A

FITTER, with Experience Large Steam Engines, Pumps, &c., REQUIRED for Gold Mine in West Africa. Wages 20s. per shift.—Address, stating age, experience, with copies of testimonials, 6500, The Engineer Office. 6500 A

REQUIRED, a Capable CLERK, with Good Knowledge of the ordinary routine of a Contractor's Office, willing to make himself generally useful; must have experience of Typing.—Application, with copies of testimonials and salary required, to be addressed, 6505, The Engineer Office. 6505 A

SITUATIONS WANTED

ADVERTISER (40), Skilled Mechanic, SEEKS SITUATION; life experience, good all-round man, experimental, light mechanical work, electrical experience, excellent references; London district preferred.—Address, P0344, The Engineer Office. P0344 B

ADVERTISER (21) SEEKS POSITION, Municipal or Civil Service, Surveyor's Office, any district; 3½ years fire insurance surveyor. Particulars.—Address, P0376, The Engineer Office. P0376 B

A.M.I.C.E. (33), Railway Locomotive Works and D.O. trained, 5½ years district locomotive superintendent, automobile, hydraulic, maintenance and general engineering experience, also commercial, used to control of large staffs, DESIRES progressive POST where initiative and varied experience are needed. Moderate salary to commence.—Address, P0378, The Engineer Office. P0378 B

APPOINTMENT as MANAGER or ASSISTANT MANAGER DESIRED by Engineer with over 20 years' general engineering experience (6 years as manager). Highest qualifications and testimonials.—Address, P0371, The Engineer Office. P0371 B

CIVIL ENGINEER (Chtd.), 12 Years' Exp. Dock Engineering, 5 years abroad general construction, DESIRES CHANGE.—Address, P0379, The Engineer Office. P0379 B

CIVIL ENGINEER (37), University Trained, 14 years' technical and commercial experience, DESIRES RESPONSIBLE POSITION, home or abroad.

Experienced in modern factory management, installation and maintenance of plant, control of staff and labour; also thoroughly experienced in carrying out all classes of building construction, reinforced concrete, pile driving, surveying, D.O., &c. Competent to represent firm of good standing.

Address, P0369, The Engineer Office. P0369 B

ENGINEER EMPLOYERS, Will You Give PROGRESSIVE CHANCE to YOUNG ENGINEER (25) in exchange for energy, adaptability and real class work in works or D.O.? Polytechnic education, 8 years' exp. shops.—Address, P0384, The Engineer Office. P0384 B

ENGINEER, Mech. (Age 24½), Technical Diploma, college education, 5 years shops, also D.O., knowledge of Diesels and steam turbines, REQUIRES progressive POST.—Address, P0367, The Engineer Office. P0367 B

EXPERIENCED MODEL MAKER, Wood or Metal, all branches, SEEKS POSITION. Winner silver cup and medal. Speciality, working models modern artillery.—Address, P0372, The Engineer Office. P0372 B

GENERAL ENGINEERING AND BRASS TRADE. WORKS MANAGER DESIRES responsible APPOINTMENT. Capable organiser, experienced modern factory management, control of labour, and general commercial practice. Highest references.—Address, P0365, The Engineer Office. P0365 B

SITUATIONS WANTED (continued)

JIG, PRESS TOOL and FIXTURE DRAUGHTSMAN-DESIGNER (Chief), with 13 years' experience, DESIRES POST, preferably London.—Address, P0368, The Engineer Office. P0368 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Cost of Shipbuilding.

Two items of news made public during the week may fittingly be placed side by side as revealing the all but impossible position in which British shipbuilding firms find themselves to-day. Speaking on the occasion of a launch on the Tyne last week, Mr. Dawson, a Newcastle shipowner, stated that he had placed an order for three steamers in Holland. Not only could British builders not guarantee a fixed date for delivery but their lowest price was £50,000, whereas the Dutch quotation was £38,500. The supplement to Mr. Dawson's remarks is to be found in some figures published by Swan, Hunter and Wigham Richardson. At the annual meeting of that company it was stated that of the sixteen undertakings owned by or associated with the firm only two succeeded in making a profit last year. That statement, it seems, has not been accepted by certain individuals among the workmen. The firm has accordingly now followed it up by publishing the certificate of a firm of chartered accountants showing the costs of building and the prices received for nine vessels built at the Wallsend Shipyard. None of the orders was accepted at a figure below the current market price, but on the nine vessels there was a total loss of £8630.

The Modern Alchemist.

THE announcement that Professor Miethe, of the Berlin Technical High School, and his assistant, Dr. Stammreich, have accidentally succeeded in discovering a method of transmuting mercury into gold would have been hailed with derision some few years ago, but to-day it is not to be discredited simply because, so far, it has not received publicity except in the daily Press. In other words, while awaiting confirmation of the reports that have been published we can, without loss of scientific dignity, prepare to find them true in substance if not in detail. So far as can be gathered, Professor Miethe, it would appear, made his discovery while carrying out some experiments on the photographic properties of a new type of mercury vapour lamp. After the current had been passed through the lamp for anything from 20 to 200 hours it was found that the mercury vapour contained minute quantities of bright-coloured crusts, which analysis placed beyond all doubt as being gold. It is curious to note that mercury was perhaps the favourite metal of the alchemists in their search for a substance that could be turned into gold. It is also of interest to note that the atomic weights of the two metals are very nearly equal, gold being 197.2 and mercury 200.0. On the other hand, it should not be overlooked that gold amalgamates very readily, and that gold amalgams occur in nature. Rigorous demonstration is, therefore, required that there was no gold at the outset either in Dr. Miethe's lamp or in its mercury vapour.

The Electricians' Strike.

THE ballot of the workers in the electricity supply industry has gone against arbitration and in favour of a strike to force the demand for a ten shillings increase in wages. The forty unions concerned decided, a few days ago, to take a ballot on the questions of whether the members were in favour of submitting the application to arbitration or of adopting a strike policy. The Joint Industrial Council for the industry met at the Ministry of Labour on July 18th, and the workers' side reported the result of the ballot, the figures being 7630 for a strike policy and 5112 for arbitration. The employers have pointed out that a recent return shows that the total numbers of workers in the industry is 20,000, and of this number apparently only 12,742 recorded their votes. At the time of writing the next step on the part of the workers in the industry is unknown, but we understand that a meeting of all the unions concerned is to be held at an early date.

The Railway Enginemen's Ballot.

IT is fairly safe to assume that many members of the Associated Society of Locomotive Engineers and Firemen, and perhaps some of its executive also, were somewhat ashamed of their officials when, last January, the signature of the Society's representative to a wages award was repudiated. Though concessions were subsequently made to the men and the strike thus brought to an end, only the most obstinate members of the Society would claim that the stoppage was a success, seeing that the companies had from 50 to 75 per cent. of their trains running when, on January 29th, terms were signed. That a wiser spirit prevails at the moment is shown by the result of the ballot as to what shall be done with respect to the men's demand for the abolition of classification and as to the guaranteed full day's pay for any portion of Sunday that may be worked. Out of 67,000 ballot papers issued 51,787 were returned and 3018 of them were either spoiled or blank. Of the 48,769 effective votes only 15,708 voted for a strike. There were 18,298 against a strike and in favour of negotiations with the companies, whilst 14,763 were also against a strike but would have the matter referred to the Wages Boards. Thus in all 33,061 of the members voted against a strike.

The Engineers' Wages Claim.

REPLYING to the claim of the engineering unions for a wages advance of one pound a week, the Employers' Federation last week stated that further consideration of the question had but served to confirm the view that the engineering industry, in its present state, could not bear the additional burden that would inevitably accrue if an advance of wages were conceded. In communicating this decision, Sir Allan Smith, the Federation's secretary, did not make any counter offer to the men's application. The unions concerned have considered the employers' statement at great length, and have decided to allow their application to stand and to call a conference to meet in London next Thursday, July 31st, for the purpose of receiving the executives' reports.

New French Submarines.

THE French submarine Requin, launched at Cherbourg on Saturday, is the first of a class designed as ocean-going boats with a large radius of action. It appears that seven other vessels of this class are still on the stocks at Cherbourg, Toulon, and Brest. Displacing 1140 tons on the surface and 1440 tons submerged, they have a length of 250ft. between perpendiculars, a breadth of 23ft., and a draught of 16ft. Each boat will be propelled by two Diesel two-cycle engines developing together 2900 brake horse-power, and a surface speed of 16 knots is anticipated. The electro-motors for underwater cruising are of 1800 horse-power for a speed of 10 knots. Sufficient oil is stowed for a surface voyage of 9000 miles at economical speed. The armament consists of one 3.9in. gun mounted on deck, and eight tubes for discharging the new 21.6in. torpedoes, of which about twelve will be carried. In addition to the Requin, this class includes the following boats: Souffleur, Narval, Caiman, Phoque, Marsouin, Dauphin, and Espadon. Six smaller submarines, rated as second-class boats, which were laid down in private yards last year, will soon be going afloat. They displace 600 tons on the surface, have a speed of 14 knots, and will be armed with a 3.9in. gun and seven 21.6in. torpedoes. Work is expected to begin this year on the second half of the submarine building programme. This measure provides for two submarine cruisers of 3000 tons, thirty first-class boats of 1385 tons, and seven mine-laying boats of 600 to 1300 tons, all of which are to be completed by 1931 at the latest.

Wireless in the Empire Pageant.

IN the representation of Mr. Marconi's first experiments in Transatlantic wireless telegraphy at Signal Hill, Newfoundland, which is being included in the British Empire Pageant, the scene will be made to conform, as far as possible, with the events which took place in December, 1901. Wireless instruments and apparatus of the type used at that time have been assembled ready for the event, and Mr. G. S. Kemp, who was Mr. Marconi's chief assistant in the Signal Hill experiments, is taking the same part in the pageant as he did at Signal Hill. The instruments themselves will not, however, be used in the Pageant but will be exhibited in the Newfoundland Pavilion.

Torquay Waterworks.

THE new waterworks in course of construction for Torquay were inspected by members of the Town Council on July 19th, and special attention was given to the reservoir at Great Hill, which, when completed, will have a capacity of 1,500,000 gallons. The scheme is noteworthy on account of the fact that the watershed from which the supplies are drawn is being planted under a regular afforestation programme, at the rate of from 30 to 40 acres a year. When the trees have matured it is intended to erect an overhead electric transmission line for supplying the power for dealing with the timber.

The End of an Old Packet.

ANOTHER of the famous old iron ships has gone in the City of Oxford, which left this country last week to go to an Italian ship-breaking yard. The City of Oxford was built in 1882, by Barclay, Curle for the City Line, and was of some 4000 tons. She was of the barque rigged type of steamer, intended for the Calcutta service, and had a speed of 13½ knots—a very good speed for those days. After being in commission for about nine years the engines were altered to triple-expansion and new boilers were installed. The ship was taken over by the Ellerman Line in 1906, and was purchased by the Admiralty shortly after the outbreak of the war. Her speed was then some 12 knots, and the purchase price is said to have been £25,000. The City of Oxford then became No. 1 of the "Dummy Fleet," or, in other words, the shadow of H.M.S. St. Vincent, which she was made to resemble in outward appearance. After serving in that capacity for some time the old ship was converted into Fleet Messenger No. 50, which entailed cutting away some of her superstructure and building a deck for accommodating kite balloons. A gas-making plant was fitted up in her foreholds, and she was capable of filling an observation balloon with 30,000 cubic feet of gas and sending it up into the air in four minutes. The next *rôle* assigned to the vessel was that of a seaplane carrier, stationed at Port Said. She came home just before the Armistice, twice escaping being torpedoed, and was offered for sale at Cardiff. The Government withdrew her when the bidding went to £30,500, but subsequently sold her back to her old owners, who reconditioned her and put her back on the Eastern Mediterranean service. Now she has been sold for scrapping for £11,000, a good testimonial to the work originally put into the hull. *Apropos* of the passing of this old steamer, it is noteworthy that good progress is being made in the re-rigging of the Cutty Sark, the last of the old tea clippers, so that she will appear as she did at the zenith of her career.

Test of a Welded Steamer.

A VERY good test of the practical value of the use of welded joints in place of riveting for ship construction is given by the ss. Caria, which was docked last week after being stranded. The Caria is the first ship ever built in which all the plating was jointed by welding and was launched by Cammell, Laird and Co., in 1920. She is of 398 tons gross, and 185 tons net, register, and is owned by the Manx Isles Steamship Company. On the way out from Manchester to Belfast, with a full cargo, she ran aground in the Mersey and remained fast while the tide ebbed. The strain of lying aground was severe enough to set in the plating of her bilges over a considerable length, but she refloated on the rising tide. It was found, however, that she had made no water and she proceeded on her voyage. Even after steaming over to Ireland no leaks developed and the vessel came back and was dry-docked at her makers' yard. Careful examination revealed the fact that there was not a single break in the plating, although, as already stated, it was considerably set up in way of the bilges.

The Gretna Explosives Factory.

IN spite of the energetic efforts made by certain Scottish members of Parliament to induce the Government to retain and exploit the explosives works at Gretna and Eastriggs, established during the war, the sale of the buildings, plant and land not previously disposed of was begun at Carlisle on Tuesday. The suggestion had been made to the Government that it ought to establish at Gretna various industries connected particularly with house building, such as the manufacture of concrete blocks, tiles, &c., carpentry productions, and so on. At the opening of the sale it was hinted that although the Government had rejected this proposal to the extent of allowing the sale to proceed as planned, it might be found that some of the buildings and plant, if not disposed of during the sale, would be retained by the Government for industrial purposes. Very low prices were realised for some of the lots offered for sale. One other big block of Government surplus property, the port of Richborough, remains unsold. The total assets for sale in the hands of the Surplus Stores Liquidation Department are now estimated to have a value of 6½ million pounds sterling. Every effort is to be made to dispose of them before the end of the current financial year.

Company Titles.

IN these days of business amalgamations and combinations the problem has frequently to be faced of devising a name for a combined undertaking that will preserve at least some connection with the titles of the separate firms before they united. It is very obvious, we think, that the problem has in some cases been approached and solved with little or no respect for euphony or even for commercial convenience and efficiency. Nearly all the big banking combinations have reduced their initially unwieldy and unpleasantly sounding titles to something short and crisp yet characteristic. The time seems ripe for some of our industrial and engineering undertakings to do likewise. In the recasting of a company's title, however, many things have to be thought of. To considerations of a purely commercial nature the President of the Board of Trade has now added one of a new kind. While seemingly anyone is free to use the word "International" in the title of a company, the designation "National" is apparently held to contain a possibility of misleading the subscribing public, and when the next revision of the Companies Acts is undertaken it may be found that "National," "Imperial," and similar adjectives will be placed under a ban so far as a new company seeking to register its title is concerned. So much we infer from a statement made by Mr. Webb in the House of Commons on Tuesday.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XIV.*

GENERAL ENGINEERING EXHIBITS.

RANSOMES AND RAPIER, LIMITED.

THE outstanding feature on the stand of Ransomes and Rapier, Limited, of 32, Victoria-street, S.W. 1, is the mobile crane, illustrated in Fig. 272. This crane has a capacity of 2 tons at 10ft. 6in. radius

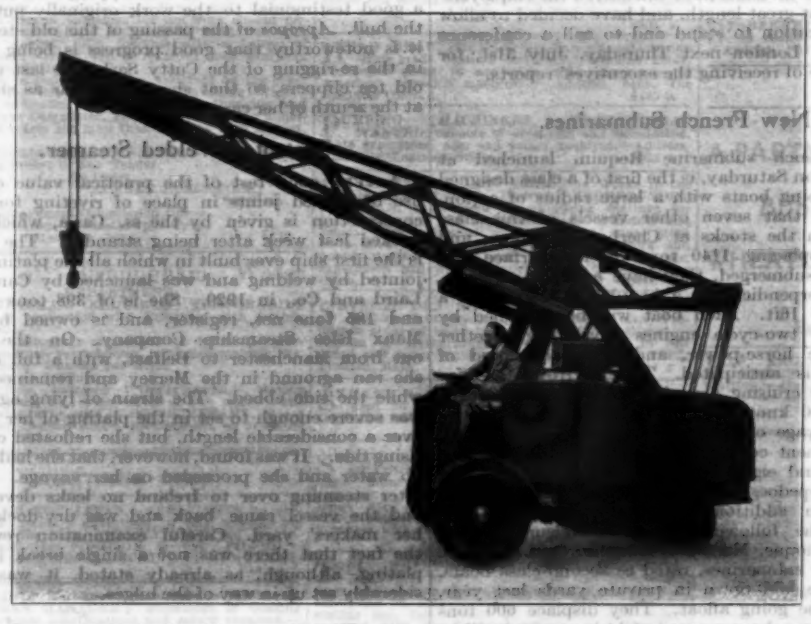


FIG. 272—PETROL-ELECTRIC MOBILE CRANE—RANSOMES AND RAPIER

and of 25 cwt. at 15ft. radius; it will lift to 16ft. above ground level and lower to 20ft. below. The jib, when carrying a load of 25 cwt., will clear an opening having a headway of 10ft. and a width of 5ft. 6in.

The particular utility of this crane lies in the fact that it can go anywhere where a petrol lorry can go; it can, moreover, be used in warehouses as well as in yards and docks and by the canal and river side. To railway companies, as a substitute for stationary cranes, it should particularly appeal, as there is no necessity to shunt out other wagons in order to get a particular wagon to the crane. The mobile crane simply goes to the wagon, wherever it may be, lifts the consignment and takes it to the lorry. Much time and engine power in placing wagons at the crane are thereby saved and, in addition, wagons can be more quickly released and be made available for return loads.

The crane is provided with two large rubber-tired road wheels, mounted on a fixed axle, in front, whilst the rear end is supported on a two-wheeled castor. The latter is mounted on a centre post and is both the driving and steering element, and its axle is articulated so as to adjust itself to uneven ground. The steering and slewing are carried out by means of suitable shafting and a steering wheel of the ordinary motor car type. The hoisting and derricking motions are performed by means of separate motors through worm and spur reduction gears to barrels mounted on a cast iron bed-plate. The travelling motion is driven by the two-wheel castor which carries two motors wired in series, each driving one wheel, the power being thus differentially applied to the two wheels. Power is generated by means of a 20 horse-power petrol engine directly coupled to an 8-kilowatt dynamo giving 240 volts at 1500 revolutions per minute.

A notable feature of this crane is its stability. By reason of the fact that the jib is always at right angles to the axis of the two front wheels the effect on the crane, should it be called upon to lift a weight greater than its capacity, is to cause the tail of the crane to rise without lifting the load. This movement warns the driver and gives him ample time to realise his mistake before the crane becomes unstable. The hoist and derrick motions are fitted with the Lewis patented solenoid electric brakes of which Ransomes and Rapier are the sole makers. They act instantly when the current is cut off.

Models of breakdown cranes, traversers, Stoney roller sluices, &c., are also shown on this stand.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., LIMITED.

One of the notable exhibits on the large stand occupied by Sir W. G. Armstrong, Whitworth and Co., Limited, is an eight-coupled locomotive built at Scotswood for the Buenos Aires Great Southern Railway. The weight of this engine in working order is 83.7 tons, and the tender turns the scale at 51.35 tons. The total length over buffers is 64ft. 3in.; the gauge 5ft. 6in.; and the diameter of the driving wheels 4ft. 7½in. There are three cylinders, each 17½in. diameter by 26in. stroke, and they all drive the second driving axle, giving at 85 per cent. of the boiler pressure, which is 200 lb., a tractive effort of 36,900 lb. An interesting feature is the employment of Walschaerts' gear for the inside cylinder. In this arrangement the connecting-rod for the reversing link, which is ordinarily actuated by a return crank on the driving crank pin is coupled to an excentric keyed to the crank shaft. The inside cylinder is inclined at 1 in 6½ to clear the leading axle, and an overhead guide bar of the single slipper type is employed. On the boss of the crosshead is formed a downwards-directed bracket or arm which drives the combining lever. The piston valves are 16in. in diameter. The boiler, which is oil-fired, has an evaporative surface of 1887 square feet and a superheater surface, measured on the inside, of 410 square feet. The inner fire-box is of steel.

A general view of the engine is given in Fig. 273 and a diagram in Fig. 274. From the former it will be seen that a Weir feed-water heater and feed pump

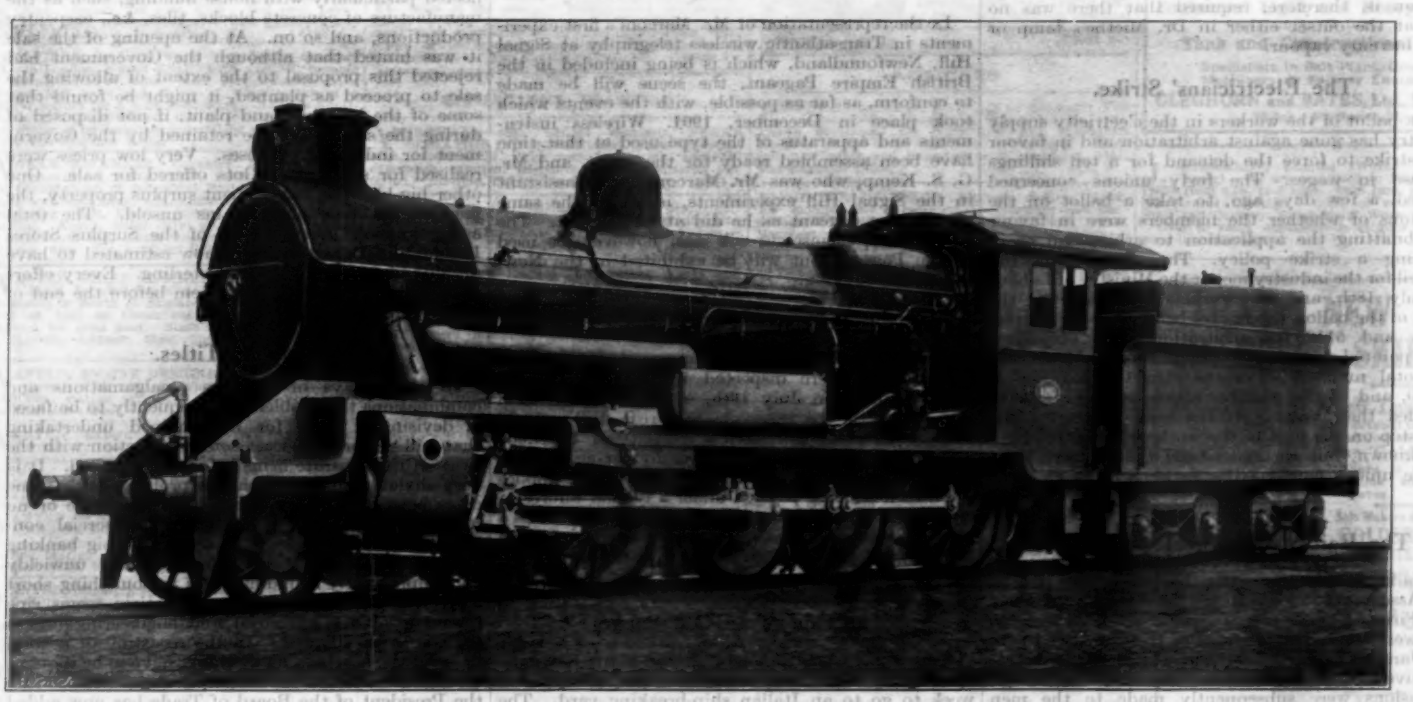


FIG. 273—LOCOMOTIVE FOR THE BUENOS AIRES GREAT SOUTHERN RAILWAY—ARMSTRONG, WHITWORTH

are fitted, and those who like an engine to look well will observe with regret the arrangement of lubricating pipes and other details on the outside of the boiler. The "port-hole" in the valve chest covers the drifting valve. The tender carries 4000 gallons of water, and 8¾ tons of liquid fuel in a removable tank. The oil is heated in a small well at the front

* No. XIII. appeared July 18th, 1924.

end of the tank by a steam coil, and is carried by a tube with spherical joints to the engine where it is again heated before passing through a strainer on its way to the burner. This burner, which is of the Best pattern, is placed at the forward end of the ash or fire pan, and the flame is projected towards the back and returns over an arch before entering the tubes. The characteristic feature of the Best burner is that the steam supply is above the oil supply, as seen in the section—Fig. 275. The liquid fuel enters the burner by gravity, is pulverised by the flat steam jets and projected backward into a central trough in the bottom of the fire pan—see Fig. 276. The hot gases then turn upward into the fire-box which is lined with fire-brick—as shown in Fig. 277. It should be noticed that the steam jet is formed by a hinged piece which is kept in position by a bridle. By adjusting this bridle the steam jet can be readily varied. The fire pan is provided with four doors, one at each end of the two air ducts in the sides of the fire pan and controllable from the footplate.

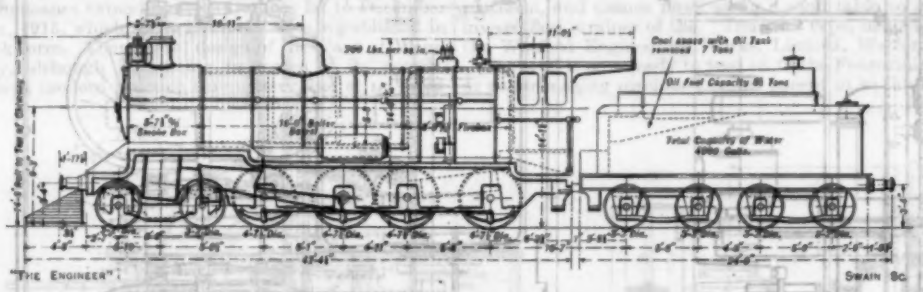


FIG. 274—BUENOS AIRES GREAT SOUTHERN LOCOMOTIVE

The air passes into the central or burner trough of the fire pan through cast iron grids.

A certain amount of air is also admitted around the burner nozzle, which does not quite fill the opening in the back wall of the burner carrier. A cleaning door is fitted at the rear end of the central trough.

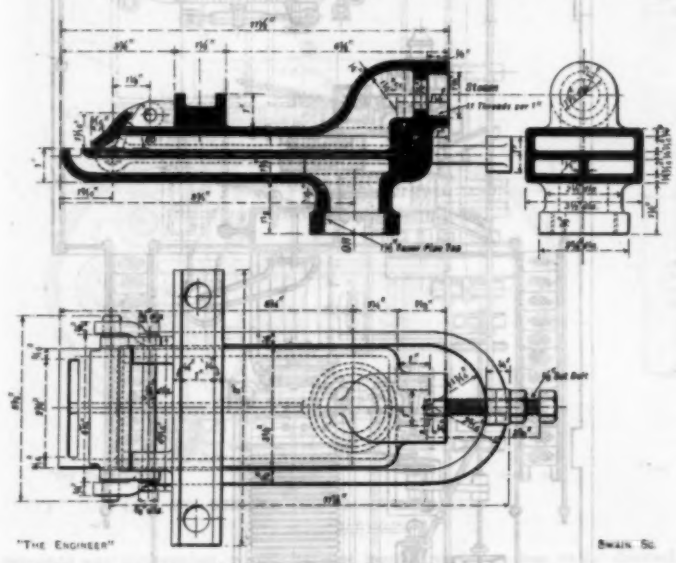


FIG. 275—BEST OIL BURNER

DORMAN, LONG AND CO., LIMITED.

The stand of Dorman, Long and Co., Limited, is undoubtedly one of the finest in the Palace of Engineering. Its design, produced by Sir Edwin Lutyens, R.A., represents an adaptation of the early Greek and Roman columnar architecture to modern methods of construction. From a base floored with teak, an entablature is supported aloft on eight gently tapering columns, four of which—those at the corners—are square sectioned, and four, disposed on two sides of the stand, circular. In his detestation of the sham, Ruskin, had he lived to visit Wembley, would, no doubt, have passed caustic comment on the construction of the stand, for the truth is that the columns are not marble, as they appear to be, but steel stanchions encased in Scagliola, a marble substitute made by a process that has come down to us from the early part of the six-teenth century. We do not grieve, however, for the hidden interior, but find the beauty of the exterior undiminished after peeping round one of the columns which at the back has been left without its marble covering in order to show its steel bones.

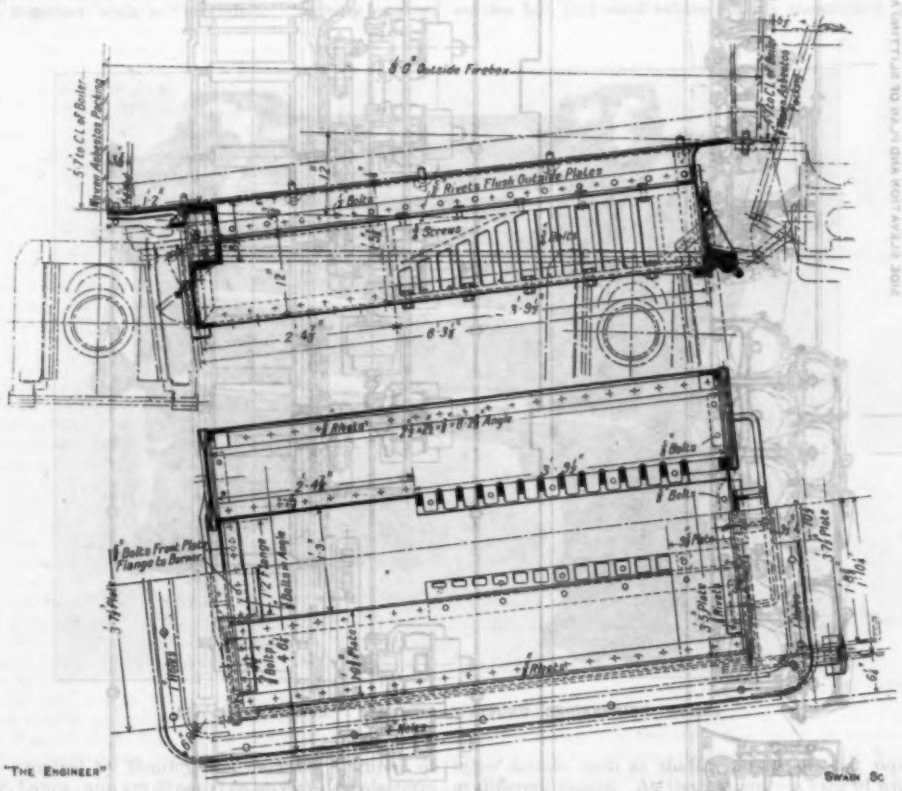


FIG. 276—FIRE-PAN FOR BEST OIL BURNER

The exhibits on the stand are illustrative of the firm's wide range of interests in the iron and steel manufacturing, constructional engineering, bridge building, colliery and mining industries. A large water colour drawing of Sydney Harbour Bridge, the contract for which was awarded to the firm last February, is a feature of great attractiveness and, in our eyes at least, proves, if proof be sought, that in modern engineering works efficiency and fitness do not perforce entail ugliness, but, on the contrary, involve a natural, unstrained dignity and beauty. The severely practical, however, dominates the rest of the exhibits, although in the very range of the firm's products there is to be caught an inspiring insight into the metallurgist's conquest over natural materials and the uses to which the engineer has put it. Coal and coke and their amazing series of valuable by-products, iron-stone, pig iron, ferro-manganese, fire-bricks and crushed slag, all derived from the firm's own mines or furnaces, represent but one section of the company's wide interests. Basic open-hearth steel in all its unmanufactured or semi-finished forms is exhibited, and serves to remind us that the firm has a capacity for producing over a million tons of this material per year. A complete series of British standard sections covering 111 different classes or sizes of beams, channels, angles and tees indicates the facilities which the company has at its command for working up its semi-finished material into the forms demanded by the engineer. Flat, round and square bars, rails of all types and steel plates are exemplified among the exhibits. For shipbuilding and constructional work the company can now produce plates from $^3/_{16}$in. to 2in. in thickness, up to 100ft. in length and up to 9ft. in width. Among the plates shown are some manufactured on the firm's universal plate mill at the Redcar works, the only mill of its kind, it is said, that is at work in Great Britain, although it may shortly not be able to continue its claim to that position. On this mill the plates are rolled simultaneously on both faces and both edges, with the result that edge shearing and machining can be eliminated by the users of the plates. The mill can produce such plates in thicknesses from $\frac{1}{4}$in. to 2in. and in widths from 15in. to 45in. An interesting contract which the firm is now executing is represented by two sections of the 72in. and 57in. riveted pipe lines being laid in India for the Bombay Municipality Water Supply. This contract, the overseas work in connection with which is being carried out by the firm's associated company, Braithwaite and Co., Limited, covers the laying of 80 miles of the larger section and 30 miles of the smaller. The plates for the pipes—80,000 tons will be required—are shipped flat to India and are bent, riveted and caulked into pipe form after arrival.

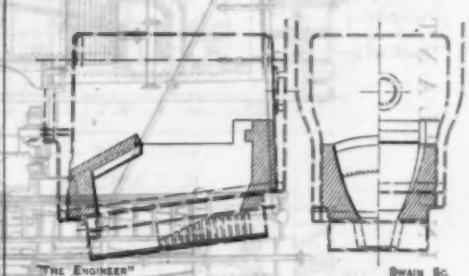


FIG. 277

MODEL PAPER-MAKING PLANT.

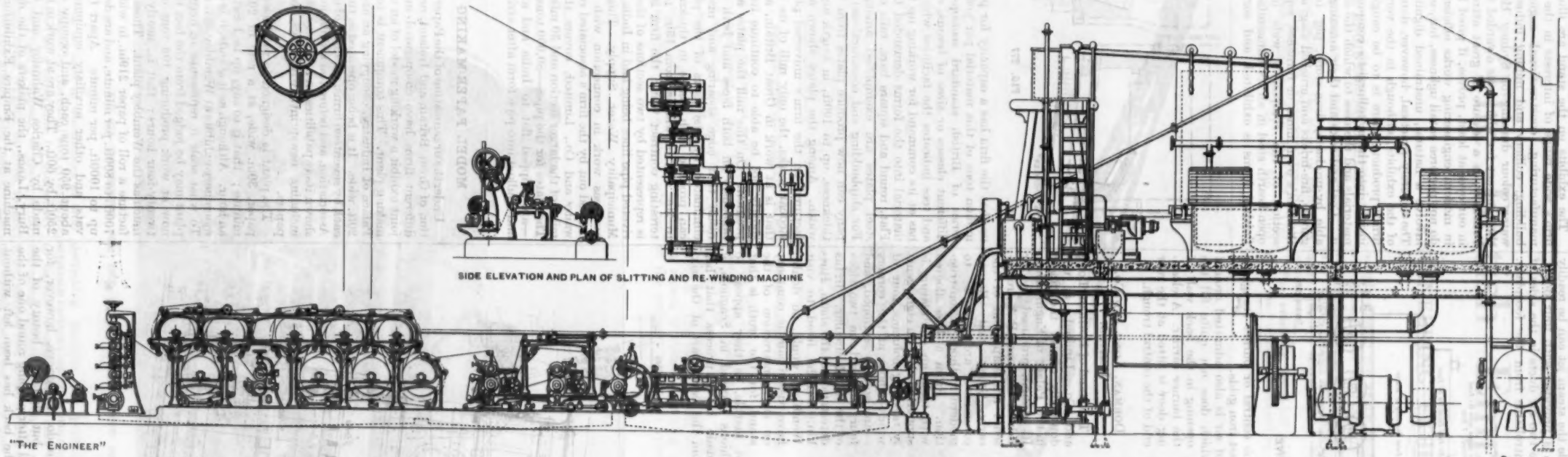
Under the organisation of the Paper Makers' Association of Great Britain and Ireland, nearly three dozen different firms have co-operated in providing as a joint exhibit a working model of an up-to-date paper-making plant. This equipment is to be found in the Palace of Industry, occupying an area 100ft. long by 20ft. wide. It is being operated in turn for a fortnight each by seventeen firms, members of the Paper Makers' Association, and before the Exhibition closes will have shown its capabilities on a variety of different papers, including newsprint, wrappings, esparto and fine papers.

The plant is designed to produce a finished roll of paper, 30in. wide, at a rate of 20ft. to 100ft. per minute; that is to say, up to 1 cwt. of dry paper in an hour. Although as it stands, it is one of the largest machinery exhibits at Wembley, it is still only a model. To what scale it represents an actual paper-making plant may be judged from the fact that machines are now at work producing 106 tons of newsprint per twenty-four hours; that is, nearly ninety times as much as the Wembley plant. These machines manufacture a roll of paper 219in. in width at a speed of 700ft. to 800ft. per minute, and are designed to operate up to 1000ft. per minute. Apart from the beaters, vats and other auxiliary equipment, they weigh about 950 tons each, and occupy an area of some 250ft. by 60ft. They are at work in Canada, and were made by Charles Walmsley and Co., Limited, of Bury, Lancs., the makers of the model Fourdrinier machine at the Empire Exhibition.

The general engineering features of a modern paper-

EMPIRE EXHIBITION—MODEL PAPER-MAKING PLANT

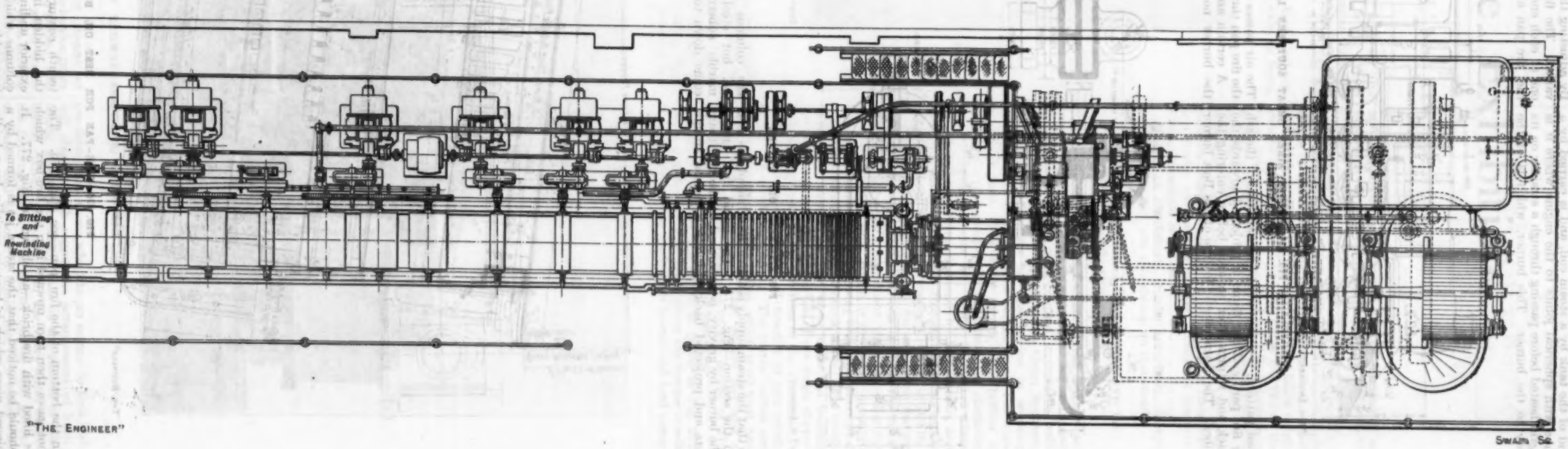
(For description see page 95)



SIDE ELEVATION AND PLAN OF SLITTING AND RE-WINDING MACHINE

"THE ENGINEER"

SWAIN Sc.



"THE ENGINEER"

SWAIN Sc.

making plant are probably already familiar to most of our readers. These features, as distinct from those of a chemical or purely paper-making nature were dealt with at length in a series of articles published in our issues extending from October 1st to December 31st, 1915, which series has since been republished in book form. The general design of the plant at Wembley, although interesting in many of its details, follows modern practice throughout, and at no point presents any innovation, which has not been already tested and tried in full-sized paper mills.

The raw material arrives at the Exhibition in the form of "half-stuff"—that is to say, with all the preliminary operations, such as washing, breaking, bleaching and purifying, already performed upon it. As received, it is thus ready to be delivered directly into the beaters. These beaters, of which there are two, together with a "Marshall" refining engine, were supplied by Bentley and Jackson, Limited, of Bury, Lancs., and are situated on an elevated platform—to be seen at the far end in the general view given in the lower engraving on page 106. Leaving the beaters, the stuff is dropped into a "rough" storage chest lying below the beater platform—as shown in the general arrangement drawing reproduced on page 96. From this chest it is pumped to a header box feeding the refining engine. After being refined, it is dropped into a "fine" chest, lying beside the "rough" chest beneath the platform. Both chests are fitted with agitating gear, which keeps the stuff in constant motion. From the "fine" chest, the stuff is pumped to a service cistern, situated on the beater platform, and thence flows along a sand table to an inward flow strainer of the "Tremor" type, made by the Watford Engineering Works, Limited, Watford.

The stuff is now ready to pass on to the Fourdrinier or paper-making machine proper, except in so far as it has to be diluted until it consists of about 1 per cent. of fibre and other matter and 99 per cent. of water. So diluted, it reaches the flow box, a receptacle fitted with a sluice which permits the flow, and therefore the weight of the finished paper, to be regulated.

The Fourdrinier, as we have stated, was made by Charles Walmsley and Co., Limited, of Bury. This firm also supplied the stuff chests, refiner header box, service box and sand tables already mentioned, and the wire and other "backwater" is caught in a tray beneath the wire table and is pumped to a chest above the beaters, from which it is withdrawn as required in connection with the beating and dilution of the stock. Just before the wire and paper reach the couch rolls, they pass over four vacuum boxes, whereby the principal part of the loose water remaining in the paper is sucked out of it. Interposed between the vacuum boxes is a "dandy roll" whereby any watermark required is impressed on the paper.

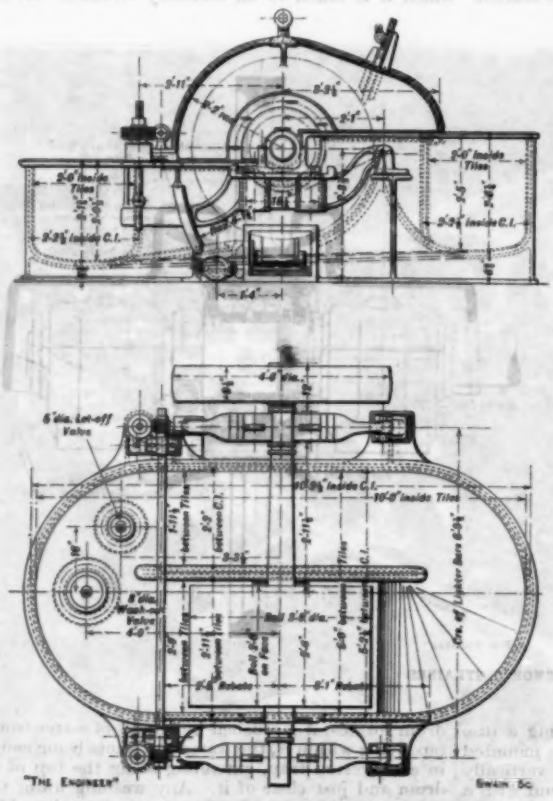


FIG. 278—BENTLEY AND JACKSON BEATER

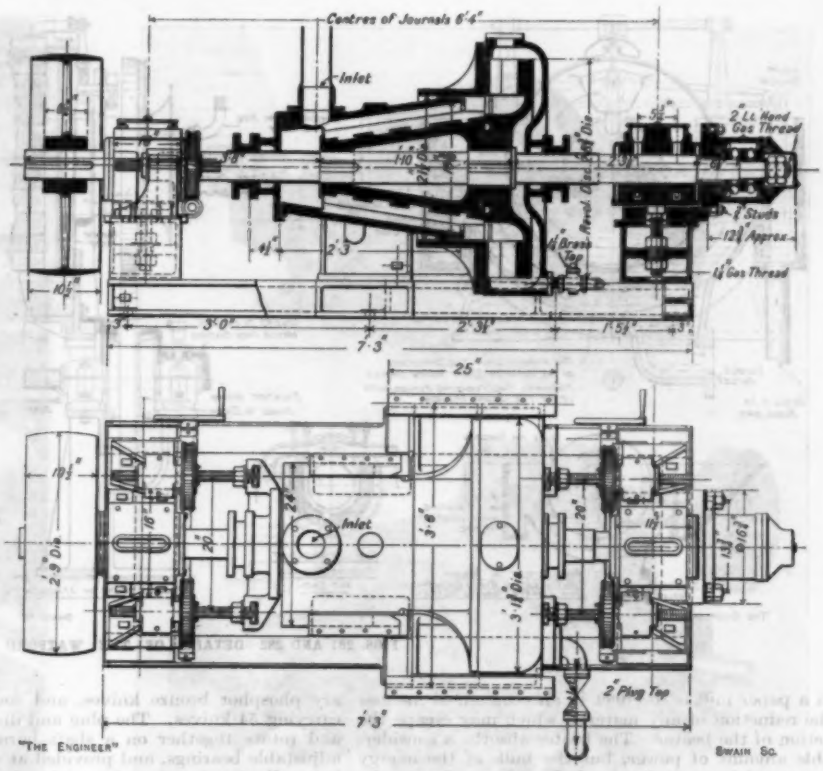


FIG. 279—MARSHALL REFINING ENGINE—BENTLEY AND JACKSON

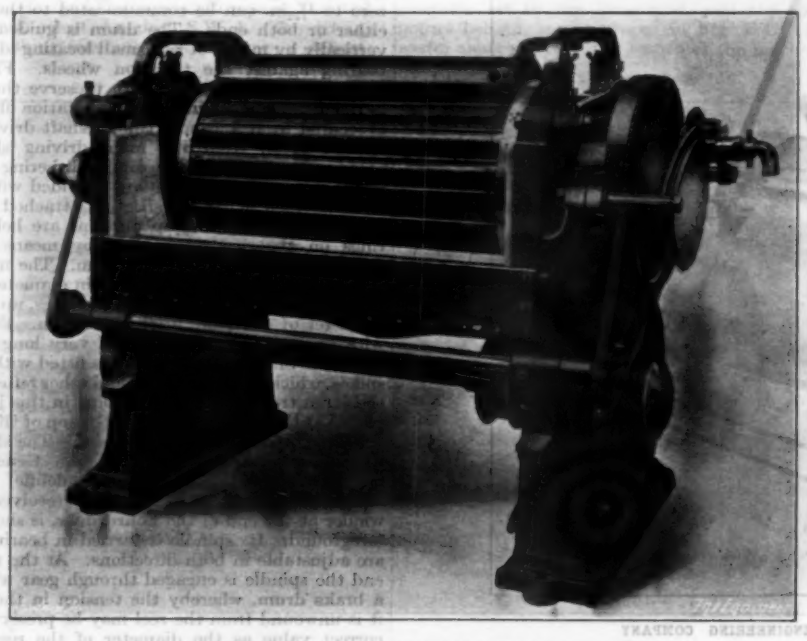


FIG. 280—"TREMOR" STRAINER—WATFORD ENGINEERING WORKS

The sheet of paper, now released from the wire, is carried forward on an endless woollen felt band to the first of two sets of press rolls. Transferred to a second endless felt, it passes through the second set of press rolls and thereafter is led to the dry end of the machine. The bottom press rolls are 9in. in diameter, and are made of cast iron covered with rubber. The upper rolls are of granite, and are equipped with "doctors," whereby fibre adhering to them is scraped off.

At the dry end the paper passes up and down over nine cast iron steam-heated drying drums, each 24in. in diameter by 36in. on the face. Contact between the paper and the drum surfaces is secured by means of endless cotton felt bands, running with the paper. Between the sixth and seventh drying drums the paper is passed through a two-bowl intermediate calender, and after leaving the ninth drum is passed through a seven-bowl finishing calender. The bottom roll only of this calender is directly driven, the remainder being rotated by frictional contact. From the finishing calender the paper is led to a winder consisting of a rotating water-cooled drum, against which the reel presses, and by which it is driven. The reel when of a suitable size is transferred to a slitting and re-winding machine, made and supplied by the General Engineering Company, Limited, of Radcliffe, Lancs. On this machine the rough deckle edges are trimmed and the sheet is slit into varying widths, which are rewound on separate spindles. As this machine is driven independently of the Fourdrinier, it can be stopped when required to permit faulty portions of the paper to be cut out and the sheet rejoined.

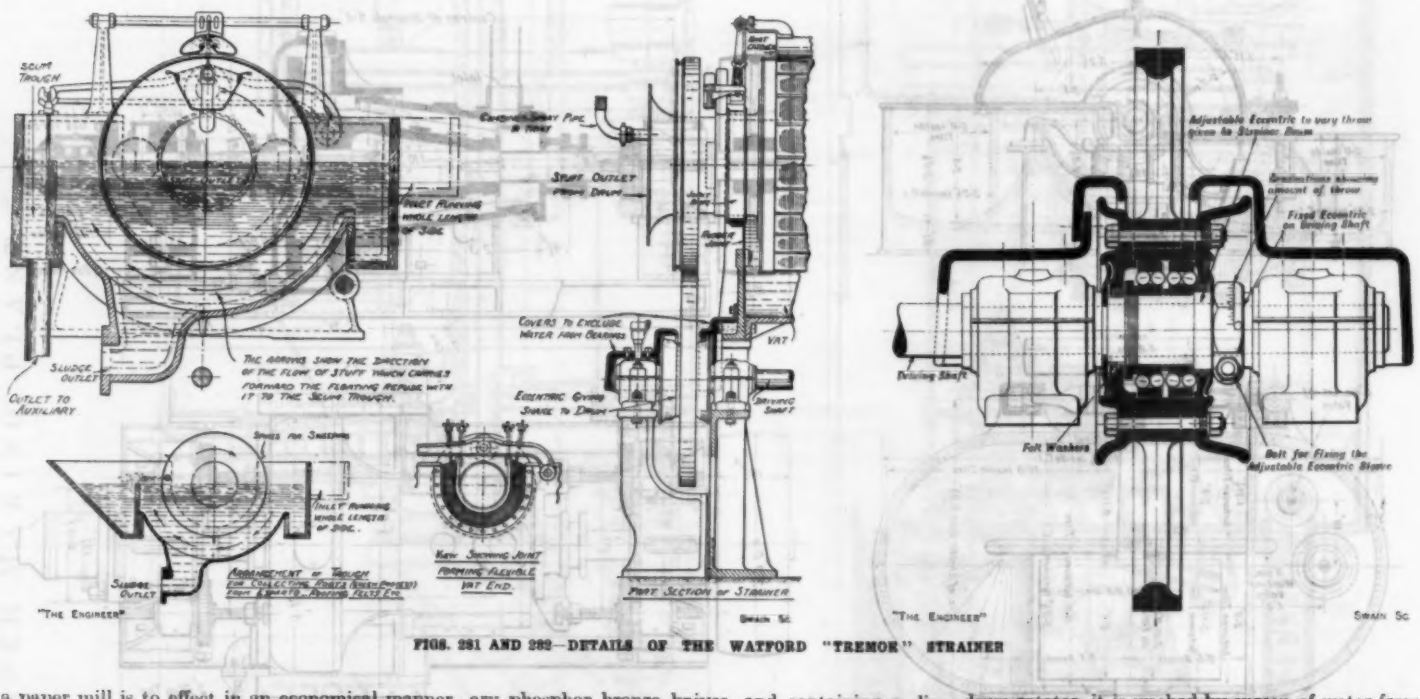
The steam required for the plant is supplied by a gas-fired boiler of 500 lb. per hour capacity, situated beneath the beater platform. This steam is used principally in the drying drums, for the whole of the plant is driven electrically.

Beaters.—The two beating engines supplied by Bentley and Jackson, Limited, of Bury, Lancs., receive the half stuff as delivered to the site, and after operating upon it for three hours or upwards, according to the quality of the paper being made, reduce it by cutting and disintegrating the fibres to a condition more or less suitable for the making of paper. Each beater has a capacity at one charge for 200 lb. of material, as measured in terms of finished paper. The trough is of cast iron in one piece, and is lined with white tiles, and—as shown in Fig. 278—is well rounded at the corners to prevent any lodgment of the material. The roll is provided with seventy-two bronze bars and works in conjunction with a bed-plate provided with thirty-two bars, arranged askew. The bed-plate is fixed, the wear of

the bars being taken up by lowering the roll. To effect this adjustment, the roll is carried in bearings mounted on pivoted and guided bridge trees or levers, one at each side, which may be simultaneously adjusted by means of a double set of worm gearing connected by a cross shaft. A sand well, with a grating and valve, is provided in the trough in front of the roll. The roll is enclosed by a pitch-pine cover. An adjustable "doctor" attached to the cover prevents the stuff from being carried round with the roll.

Refining Engine.—The duty of a refining engine in a paper mill is to effect in an economical manner the reduction of any material which may escape the action of the beater. The beater absorbs a considerable amount of power, but the bulk of the energy consumed is spent in circulating the stuff over the back fall and round the mid-feather, only a small amount representing the effective work spent in disintegrating and shearing the fibres. To reduce the last particle of fibre in the beater thus calls for the circulation of the whole charge at almost full power. Economy will obviously be secured if the reduction of the residuum can be effected in a machine that will allow the already reduced stuff to escape through it at once, while retaining the unreduced particles until they have been sufficiently disintegrated to follow the bulk of the charge. This is the duty of the refiner. The refining engine working in conjunction with the Wembley plant is of the Marshall type, and, like the beaters, was made by Bentley and Jackson, Limited. Its general arrangement is shown in Fig. 279. The stuff from the beater is passed into a chest, whence it flows continuously through the refining engine. It reaches the refining engine from an overhead feed-box, which is connected to the refiner casing by a flexible rubber hose. The casing is conical in form, the inlet being on the top of the small end, and the outlet on the horizontal diameter of the large end. The interior of the casing is furnished with 128 phosphor bronze knives, which work in conjunction with 42 similar knives mounted on a conical plug in the casing interior. At the large end the casing swells into a disc chamber provided with 140 stationary phosphor bronze knives, and containing a disc carrying 54 knives. The plug and disc are mounted and rotate together on a shaft borne in vertically adjustable bearings, and provided at one end with a belt pulley, and at the other with a double ball-thrust bearing. The exact positions of the plug and disc longitudinally on the shaft are separately adjustable by means of two sets of hand-operated worm gearing. It will be gathered that the bulk of the half stuff flows quickly through the machine, but that any portions of fibre not sufficiently reduced are held back until they have been divided to the required degree by the action of the plug and disc knives. The quality and finish of the paper is materially affected by regulating the proportional amount of work done by the plug and the disc.

Strainer.—The inward flow "Tremor" strainer, supplied by the Watford Engineering Works, Limited, of Watford, is illustrated in Fig. 280. This appliance, it may be remarked, bears no relationship to the Vibromotor strainer made by the same firm, a device embodying Mr. W. W. Beaumont's very interesting vibrating drive. Neither the rotation nor the "dithering" of the drum is dependent, as in the Vibromotor strainer, upon the centrifugal force of an excentric weight. Both are secured by direct driving means. The stuff enters the vat along the full length of one side, and after being strained passes out through a central opening at one end of the drum. The refuse, which fails to pass through the slits in the drum, passes to a scum trough—see Fig. 281—from which it is taken to an auxiliary strainer. As the drum rotates, it is washed by sprays of water from a pipe lying within it, the water and knots being caught in an inverted tray, extending along the top of the drum and just clear of it. Any washing water that fails to pass through the slits is not allowed to dilute the stuff within the drum, but is caught and led off by means of a tray fixed inside the drum, just below the spray pipe. The drum is provided at each end with a plain edged wheel, one closed and the other open, with a bell-mouthed orifice for the outlet of the strained stuff. These two wheels rest upon two other wheels, mounted on the main driving shaft of the machine. Each of the second pair of wheels is carried on ball bearings surrounding an excentric sleeve, which itself surrounds an excentric portion on the driving shaft—see Fig. 282. By adjusting the excentric sleeves relatively to the excentric portions of the driving shaft, a vertical movement varying from zero to $^1/_{32}$in. can be communicated to the drum at either or both ends. The drum is guided to move vertically by means of two small locating idler wheels bearing against the trunnion wheels. Flanges on these locating wheels serve to preserve the position of the drum longitudinally. The rotation of the drum is secured by belt from a countershaft driven at any desired speed from the main driving shaft. To accommodate the rotary and "dithering" motion of the drum, the vat ends are provided with flexible joints formed of rubber sheeting attached to deckle straps. The deckle strap portions are held against rings on the drum trunnions by means of arms, which rise and fall with the drum. The machine at the Exhibition has a drum 23in. in diameter by 42in. in length. It is also made in larger sizes, up to a drum diameter of 42in. and a length of 90in. For dealing with esparto and other stuff of very long fibre, the drum—as shown in Fig. 281—is fitted with external spikes, which sweep the roots and other refuse towards the scum trough. The spray pipe in this instance is placed at the side instead of at the top of the drum.



FIGS. 281 AND 282—DETAILS OF THE WATFORD "TREMOR" STRAINER

Slitting and Re-winding Machine.—The slitting and re-winding machine, made by the General Engineering Company, Limited, of Radcliffe, Lancs., is illustrated in Fig. 283. The reel as received from the winder at the end of the Fourdrinier, is shown in the foreground. Its spindle is carried in bearings, which are adjustable in both directions. At the right-hand end the spindle is engaged through gear wheels with a brake drum, whereby the tension in the paper as it is unwound from the reel may be preserved at the correct value as the diameter of the reel becomes reduced. The unwinding of the reel is effected against the resistance of this brake, and of the various guide rollers over which the web subsequently passes, entirely by the pull applied to the paper at the re-winding end. As the strength of newsprint is about 10 lb. per inch width, something like 300 lb. is available for this purpose in the present instance. The slit reels are re-wound by allowing them to rest on top of two power-driven rollers. The smaller of these rollers is driven from the larger by a cone belt drive, whereby the friction applied to the reels may be adjusted. The paper is slit by means of four circular

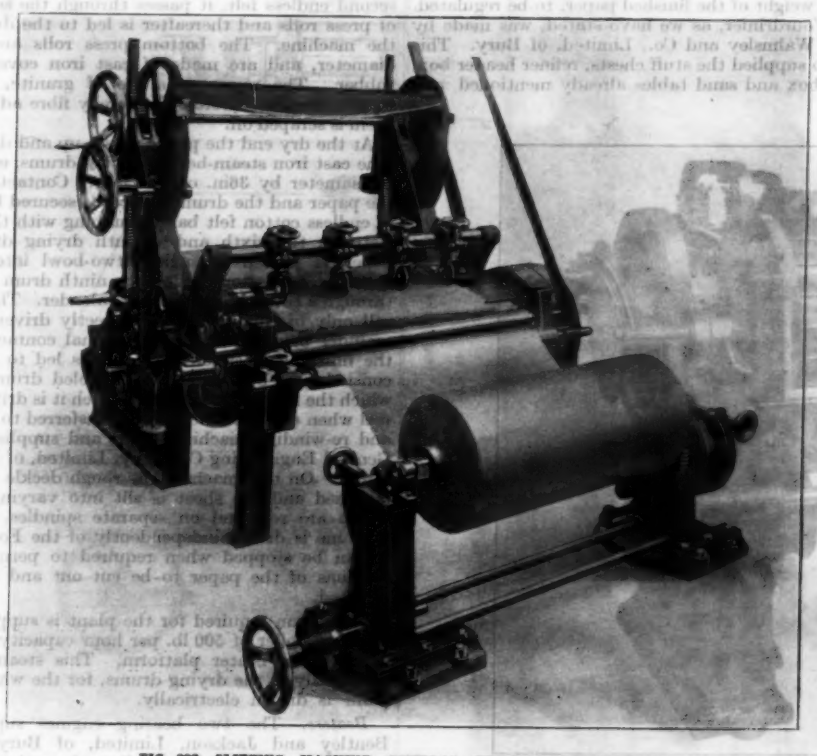


FIG. 283—SLITTING MACHINE—GENERAL ENGINEERING COMPANY

knives running above an adjustable board. Between the knives and the take-off reel, a balanced roller is provided, which, should the web break, comes into action and stops the unwinding by applying the brake to the take-off spindle. To enable the re-wound reels to be readily removed from the machine, the winding-on spindle is carried on racks, which may be raised by means of a hand wheel connected to the racks through double-purchase gearing.

The General Engineering Company has also supplied for the plant two centrifugal stuff pumps, and the vacuum pump, which is connected with the vacuum boxes at the wet end of the Fourdrinier. The vacuum pump is of particular interest in that it is of the Feuerheerd type.

Electrical Drive.—The machine, as we have already stated, is driven electrically in accordance with the system of the Harland Engineering Company, Limited, 72-74, Victoria-street, London, S.W. 1. The driving of a papermaking machine is at all times a delicate operation. The speed of the various parts has in the first place to be capable of overall variation in order to suit the quality of paper being made. Secondly, for any given quality the speeds of the various sections have to be capable of independent adjustment in order to obtain the requisite "draw" on the paper. It is not sufficient to arrange for a uniform linear speed from the breast roll to the reel-up, for as the paper becomes drier it contracts, so that as the reel-up is approached the peripheral speed of the drums or rolls over which the paper passes has to be decreased. At the same time, in order to preserve a requisite tension in the paper, it may be necessary to increase the speed of some of the sections above the specific value. If, then, the paper is neither to be torn nor allowed to sag, delicate setting of the speed of the various sections of the machine is essential. In the third place, the sectional speeds being set, they must obviously be maintained with great relative constancy among themselves during the run.

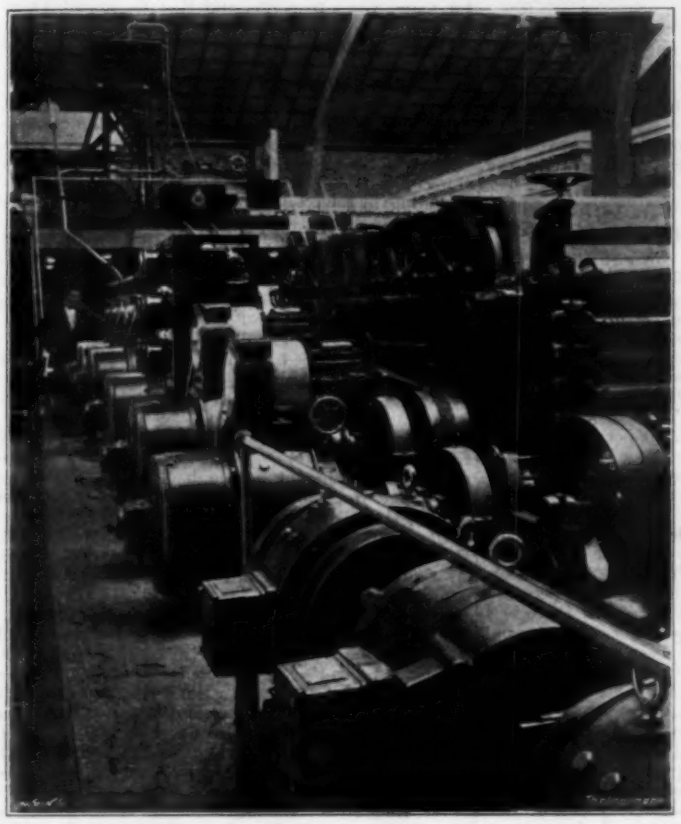


FIG. 284—HARLAND ELECTRIC DRIVE

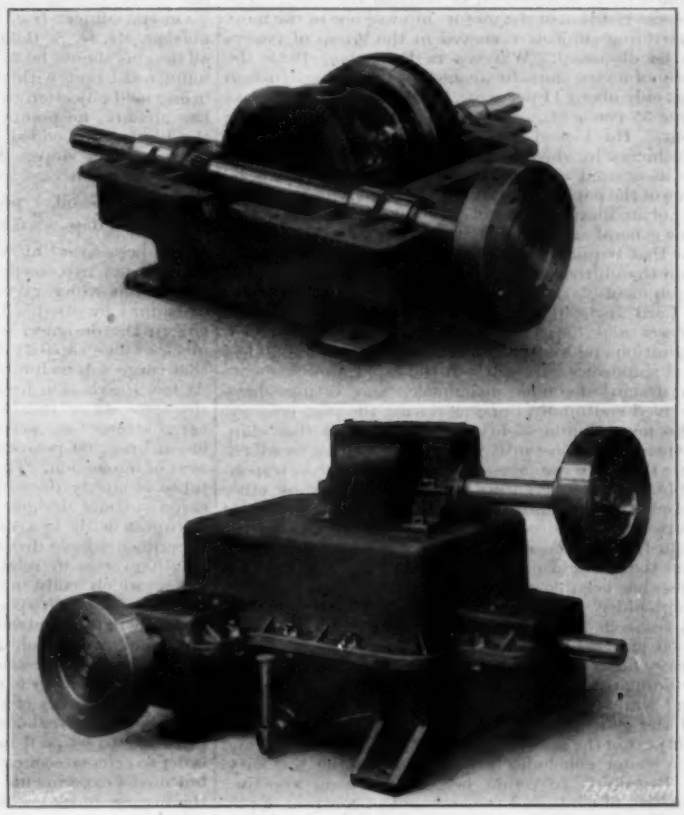


FIG. 285—DIFFERENTIAL GEAR OF HARLAND DRIVE

In the Harland drive as applied to the machine at Wembley each section is driven by a separate motor rated at 2.5 horse-power each at a speed of 150 revolutions per minute. The motors are fed from a 15-kilowatt motor generator set, separate excitation being provided for the fields. A photographic view down the rear side of the machine, showing the generator set in the foreground, and the sectional motors behind, is reproduced in Fig. 284. A light master shaft runs the full length of the machine and is driven by a separate master motor. In the case of a larger machine this master shaft is generally driven from one of the drying section motors. At every section of the machine the master shaft carries a light conical pulley. From each such pulley a belt is taken to a corresponding cone pulley on one of the three shafts of a differential gear, shown in Fig. 285. The second shaft of the differential is driven by chain and sprocket wheels from the motor associated with the section, which motor may be coupled directly or through gearing with its section of the machine. The third differential shaft is coupled to a regulator, Fig. 286, which controls the speed of the sectional motor.

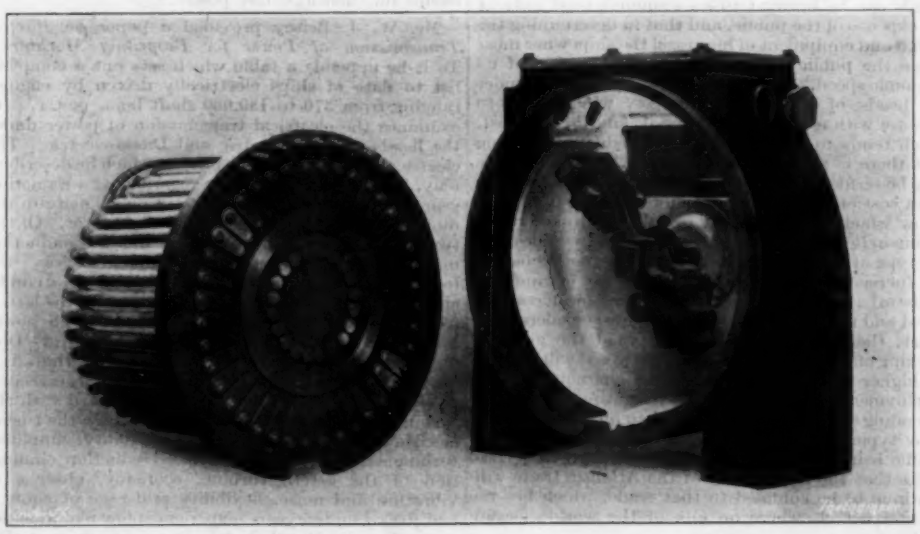


FIG. 286—HARLAND DIFFERENTIAL REGULATOR

The speed of the third differential shaft is the resultant of the speeds of the two others. If the first and second shafts are running at the same speed the third shaft will be stationary. The speed of the first differential shaft depends upon the speed of the master shaft and on the setting of the belt on the cone pulleys. Let it be supposed that with the first and second shafts running at equal speed and the third stationary, the belt on the cone pulleys is moved so as to increase the speed of the first shaft. The equilibrium being upset, the third shaft acquires movement and the regulator arm turns on to fresh contact studs, the connections of which are such that the field of the motor is varied in the direction required to give increased speed. When the arm has moved sufficiently far to bring the motor speed up to such a value that the speeds of the first and second differential shafts are again equal, the arm ceases to move and the motor settles down to a constant increased speed corresponding with the new belt setting. Although the number of contacts in the regulator is limited, it is claimed that the gradation of speed obtainable is infinite, for if the speed called for lies between those definitely associated with two adjoining contacts the arm will gently oscillate between those contacts and give the required intermediate speed.

The reverse action takes place when the belt is adjusted to reduce the speed of the section. Should the speed of the master motor and the master shaft vary or be varied, the speeds of all the sectional motors will change proportionately. If the speed of any sectional motor vary the contact arm of the regulator will acquire motion until the sectional speed has been brought back again to that normally corresponding with the belt setting in use for the time being.

The Harland drive, it may be remarked, has been applied to many machines in this country and abroad, and in particular is in use on the record breaking machines in Canada, referred to at the beginning of this notice. It is applicable, the makers claim, to the driving of plant, other than papermaking machines, in which accurate speed regulation is required, such as steel mills rolling continuous strip.

STANDARD STEELS FOR AUTOMOBILES.—Four publications dealing with automobile steels have recently been issued by the British Engineering Standards Association. They cover the chemical composition, heat treatment, mechanical properties and margins of manufacture of sixteen wrought steels, seven cold-worked steels, four valve steels and four classes of steel tubes commonly used in the automobile industry. Each publication also contains a series of general clauses relating to heat treatment definitions, method of carrying out the mechanical tests, preparation of test samples, and particulars of the standard tensile, bend, and notched bar impact test pieces. A similar publication on sheet steels for automobiles has just been completed and will be published within the next few weeks.

The World Power Conference.

No. IV.*

POWER FOR WATER TRANSPORT.

SIR WESTCOTT ABELL presided over the morning session of a meeting which, on Thursday, July 10th, discussed the problems of sea transport. Sixteen papers were presented.

The Chairman said it was important to realise that the question of sea transport was as much one of reliability as of technical or thermal efficiency. The present position of the motor ship was one of the most interesting subjects reviewed in the group of papers to be discussed. Whereas in December, 1922, the ratio of motor ships to steamships under construction was only about 11 per cent., in December, 1923, it was over 35 per cent., and for June, 1924, was 45.6 per cent. He looked for developments in propelling machinery in which a high-speed Diesel engine would be associated with some form of transmission gear. One of the papers to be submitted dealt with the working of auxiliaries on Diesel engine ships, but while there was general agreement that electricity should be used for that requirement, it was certain that more attention than hitherto must be given to the details of the equipment.

Lord Inchcape, in an introductory paper, *Shipowners and Shipbuilders*, emphasised the close co-operation and mutual good faith between shipbuilders and shipowners, from which the rapid improvements in design of hulls, machinery, and fittings have derived continuous impetus during the past century. The main points of his contribution are that shipowners have constantly been found willing to adventure their own resources or to make themselves responsible for the adventure of the resources of other people in the building and commercial operation of ships; that the contribution of shipowners to the industry has consisted in money, business acumen, and the fruits of practical experience; but that progress has been possible only by co-operation with the shipbuilder, whose part in the matter has consisted in research, the encouragement of inventive genius, good craftsmanship and willingness to shoulder the heavy financial liability entailed by provision of shipbuilding yards and engine shops with all their manifold and varied appurtenances. The gradual elevation of the general standard of technical attainment on the part of the *personnel* engaged is commented on, and the writer concludes with a note on the necessity, if Britain is to retain her place among maritime nations, of continued research and of constant appreciation of the work and progress of rivals abroad in a trade that essentially lends itself to international competition.

Mr. Basil Lubbock, in a review of *Sail, its Early History and Development*, follows the evolution of seagoing craft from the time of the Phœnicians and Solomon through the days of the simple square sail of the northern races and the lateen sail of the Mediterranean. He ascribes the latter-day fore-and-after to the latter, and the combination of square rig, mizzen and headsails in the mediæval and modern sailing ship to both. We should, he states, marvel, not so much at the small tonnage of the average seagoing vessel of the Elizabethan era, as at the hardihood of men who put out in those ships on long voyages of discovery into uncharted and unknown seas, with humble instruments of navigation. He traces the birth of regular passenger traffic in the trades to the East and West Indies mostly in newly built sailing ships, which followed the discovery of gold in Australia and California, the development, in the 'sixties and 'seventies, of the clipper ship, and the struggle with the oncoming steam vessel, which completely drove the clipper from the ocean trade routes. Those who loved the sailing vessels for their grace of form and movement will not cavil at the note with which Mr. Lubbock's paper ends. In his dirge at the passing of the clipper ship he is by no means alone.

Under the head of *Steam and the Measurement of Power*, Mr. Hector C. Bywater surveys the passage of marine engine design through its various phases, examining in some detail the outstanding characteristics disclosed by each step. He recalls that the use of the surface condenser, fitted in the Sirius and British Queen in 1838, was not revived until 1860, and that the increase of steam pressures was closely related to its general adoption. He traces the reduction of coal consumption per indicated horse-power hour and the gradual reduction in the weight of machinery, and recalls the test by the Admiralty in 1865, in three naval vessels of similar dimensions, of trunk, simple inverted and compound engines and the resulting consumption figures during one week's steaming of 3.64 lb., 3.17 lb. and 2.51 lb. per indicated horse-power hour respectively, which was followed in 1870 by the general adoption of the compound engine. By 1871 coal consumption had been reduced to 2.1 lb. per indicated horse-power hour. Triple expansion was, in 1881, shown to be sound by experience gained with the engines of the Aberdeen; quadruple expansion appeared in the St. Louis and St. Paul in 1894, with a steam pressure of 200 lb. per square inch and consumption 1.4 lb. per indicated horse-power hour. The use of superheaters and feed-water heaters as aids to fuel economy had yet to be realised. The writer then reviews the remarkable progress which has since been made with turbine machinery, emphasising its lesser weight and dimensions, and its lessening of consumption to the equivalent of 1.23 lb. per indicated horse-power hour. He notes the advantages of the turbine-electric drive, the general adoption of which has been retarded by its relatively higher fuel consumption. The paper concludes with detailed references to various types of boilers, including those fitted with forced draught, and to the adoption of oil fuel for raising steam in fast liners.

On the subject *Hull Resistance and Power for Propulsion*, Mr. G. S. Baker premises that the object of all designs should be to keep the resistance at a minimum consistent with other demands. The old and firmly held objection to hollow lines in merchant hulls has already, he points out, had its deathblow, and the bluff round-ended bow is disappearing from all but very slow ships. Mr. Baker postulates that the speed for which

$$\frac{\text{cost of coal or oil}}{\text{burnt per day}} = \frac{\text{profit per day}}{\text{earned by ship}} + \frac{\text{capital charges}}{\text{per day}}$$

is the best speed at which to run any ship. That speed is not necessarily the most economical in fuel, but is that which gives the largest profit per pound of capital invested. The latter consideration must govern the designer, who in settling his dimensions must assume capacity for a fixed weight of cargo, or that cargo will be limited only by the size of the ship. At low speeds skin friction is 80 per cent. or more of the total water resistance; in a well-shaped ocean cargo steamer at service speed, 70 per cent.; in an ocean liner, 60 per cent.; depending largely on the area of immersion. The remainder of the water resistance is chiefly due, in liners, to wave making; in cargo steamer designs there is eddying around the sternpost with loss of propeller efficiency. Model experiments have disclosed the economical minimum length of run in relation to 'midship section area below which eddy making will demand increased power for a given speed. For any speed there is a certain length of entrance and run necessary to avoid abnormal wave making. The best compromise in lightly freighted vessels with a broad water line can only be obtained by experimental models. Mr. Baker develops the theory of wave making resistance through a mathematical scale, which shows that a considerable price has to be paid in reduced carrying capacity in order to achieve economy in propulsion at high speeds; but model experiments will, he claims, always disclose the highest block coefficiency associated with a minimum of resistance In fine weather wind resistance is a negligible quantity, but a 20-knot head wind will rob a liner of half a knot of speed; as to sea resistance, analysis of data derived from North Atlantic services shows resistances up to 30 per cent. for moderately rough weather, and a higher figure in weather which is really rough. The paper seeks to demonstrate that the greatest propeller efficiency which can be obtained slightly exceeds 80 per cent. He concludes that no research work can be more profitable than that which is being directed, both by model and full-scale experiment, in America, Germany, England and other countries, to the improvement of propeller design.

In his paper on *Sea Speeds and their Costs*, Mr. Alexander Gray demonstrates that the cost of high speeds can be brought to an economic level only at the expense of the public, and that in determining the design and equipment of his vessel the shipowner must gauge the public demand in his computation of its economic speed. Mr. Gray divides voyage costs under the heads of (*a*) general charges, which tend to increase with a reduction of speed, and (*b*) fuel cost, which tends to decrease by speed reduction, adding that there is some point of speed, which he suggests may be termed "the natural speed," above which the extra cost of (*b*) would outweigh the saving in (*a*) and below which the extra cost of (*a*) would exceed the saving in (*b*). It follows, he says, that if, by improving the type of ship, the capital and maintenance charges are increased, the equilibrium between (*a*) and (*b*) is disturbed, it can only be restored by an increase in speed and fuel consumption. Revenue considerations apart, the natural speed should yield the greatest working efficiency, but the economic speed will usually be higher and will vary with the character of the employment. A table is given illustrating the rapidly ascending scale of costs in relation to increase of speed of a typical liner of 16-18,000 tons displacement. Traffic being the determining factor, the writer considers that the high speeds of the Atlantic trade will continue to be confined to that trade, which has no counterpart elsewhere on any of the world's ocean routes.

In a contribution on *Marine Fuels and Fuel Consumption*, Mr. F. J. Leathers examines the reasons for the general preference of modern shipowners for oil-fired furnaces, but concludes that coal must remain the common fuel in tramp steamers and on routes where its calorific value in relation to cost is greater than oil. He makes a strong protest against the regulations of certain ports and authorities—some within the British Empire—which, framed in other times with other aims, or instituted for protection of local coal industries, survive in obstruction of the use of liquid fuel by ocean-going vessels. He impresses upon owners who have adopted oil fuel for their ships the need to discard their former coal bunkering conceptions, remarking that the cheapest port for coal bunkers is frequently not the cheapest port for oil, and that fuel oil may sometimes be most advantageously obtained in the neighbourhood of refineries far distant from the source of the crude product. He urges the value of research by the oil-producing corporations directed towards refinement of hitherto unsuitable heavy oils in order to convert them for use in internal combustion engines. He concludes that the world's deposits of oil are sufficient for all possible marine needs in internal combustion engines for many years to come, and that its wasteful consumption under boilers will be tolerated only for so long as may be necessary to bring the motor vessel abreast of the world's need of ocean transport.

Mr. A. P. Chalkley, in a paper on *The Motor Ship—Development and Present Position*, states that while the Selandia, 1912, was the first example of the employment of Diesel engines in a large ocean-going vessel, a good deal of experience had been gained on smaller ships on the Caspian Sea or Volga in preceding years, including, in 1908, two tank vessels of 4200 tons deadweight. In all these vessels it is probably correct to say that more troubles arose with the reversing gear than with the Diesel machinery itself. The Vulcanus (1180 tons deadweight), built in 1910, is still in regular service, and her six-cylinder engines of the four-cycle type resemble in important details motors of the same class built to-day. The Toiler, built on the Tyne in 1910, was equipped with 450 horse-power Polar Diesel two-cycle engines, and the Selandia, of 7500 tons deadweight, was fitted with twin-screw Burmeister and Wain Diesel engines of 1250 indicated horse-power to give a speed of 10–11 knots. She was shortly followed by the sister vessel Jutlandia, and it was soon realised that the oil engine had demonstrated its suitability for the propulsion of large ships. In July, 1914, there were 297 motor ships in service, with a total gross tonnage of 234,287. In July, 1923, the figures were 1831 vessels of 1,668,414 gross tons. At the beginning and end of 1923 the motor ship tonnages building were 288,057 and 634,027 respectively, and the latter figure included ten ships averaging 15,800 gross tons, the largest being vessels of 22,000 tons with twin-screw machinery of 20,000 indicated horse-power. The percentage of motor to steam tonnage laid down in the last quarter of 1922 was 14; for the last quarter of 1923 it was 80.5 per cent. Marine Diesel engines up to 10,000 indicated horse-power are now being built and 12,000 to 16,000 brake horse-power in one engine may, he thinks, be expected.

Mr. Richard W. Allen, in a note on *Diesel Auxiliary Machinery*, remarks that the application of the Diesel engine for the driving of auxiliary machinery has lagged but little behind its employment for propulsion, the plan generally adopted being that by which power is derived from a dynamo or dynamos driven by one or more independent Diesel engines. To-day there are ships with installations comprising four 300-kilowatt sets, and even larger installations are contemplated, the tendency being towards a number of units of the same size, with resulting interchangeability of parts, greater load flexibility and convenience of overhaul. Mr. Allen is of the opinion that on mercantile vessels the Diesel engine will gradually supplant steam, and that, following this tendency, vessels will increasingly tend to rely upon the Diesel engine for their auxiliary power.

Mr. W. J. Belsey provided a paper on *Electric Transmission of Power for Propelling Machinery*. To it he appends a table which sets out a complete list to date of ships electrically driven by engines ranging from 370 to 180,000 shaft horse-power. He examines the electrical transmission of power under the heads of turbo-electric and Diesel-electric. The electrical equipment of the former, which he describes, may, he says, as a whole, be regarded as a reduction gear having a ratio of reduction proportionate to the number of poles on the generator and motor. Of the two types of alternating-current motors—induction machines and self-starting synchronous motors—the former is, owing to the ease with which the poles can be changed, generally used on battleships, and the latter, from its simplicity of construction and high power factor and high efficiency, in merchant ships. Diagrams illustrate the connections between the alternator and the synchronous or induction motors respectively. In both cases control is interlocked with the turbine valve gear. The writer claims for the turbo-electric drive the advantages of reliability, simplified turbine construction, efficient speed reduction, elimination of the astern turbine, economy, absence of vibration and noise, flexibility and ease of control, and (based on ten years' experience) low maintenance cost. For the Diesel-electric drive it is claimed that by coupling comparatively small engines to a generator the system may be successfully adopted in the largest liners, as the arrangement and speed of the engines are independent of the propeller shafts, between which and the engines there is no mechanical connection; furthermore, the placing of bulkheads to comply with Board of Trade or Lloyd's regulations is simplified, and the same prime mover may be used for both propelling and auxiliary purposes. Mr. Belsey holds that direct current is preferable in vessels needing up to 3000 shaft horse-power on one shaft, and that beyond that power alternating current is to be preferred. In conclusion, it is pointed out that,

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whether with Diesel-electric or turbo-electric transmission, accurate measurement of power is obtained and the amount of power for a given speed in varying conditions of hull and weather may be accurately gauged.

A paper on *The Four-cycle Type of Diesel Engine*, of which the authors are anonymous, states that the four-cycle engine has behind it a satisfactory experience of twelve years. Its advantages are said to be that it lends itself more readily to high-speed running than the two-cycle type and has better piston lubrication and lower consumption of lubricating oil, as well as a lower fuel consumption. In some of the low-speed long-stroke four-cycle engines recently constructed the consumption has not exceeded 0.38 lb. per brake horse-power hour. Reference is also made to the double-acting four-stroke engine which has rendered commercially possible the use of the Diesel engine in large passenger boats in installations totalling 20,000 indicated horse-power on two shafts.

In a contribution dealing with *Two-cycle Diesel Engines*, Mr. Robert Traill claims that the two-cycle systems permits of greater simplicity of construction than the four-cycle, and can be built in smaller dimensions and reduced weights in proportion to the power developed. He comments on the fundamental advantage of the two-cycle engines that it gives practically double the power of the four-cycle in a cylinder of given dimensions. Reference is also made to the simplicity of design of the two-cycle type, which is most apparent in the construction of the cylinder cover, and in the valves and starting and reversing gear. He claims that the fuel consumption per brake horse-power hour is the same as for the four-cycle type. Other points emphasised in the paper are the more even turning moment of the two-cycle engine, smaller number of cylinders for an engine of given power and the use of supercharging, thereby increasing the efficiency of combustion at the highest load. The double-acting engine is being developed, but the piston speed in some of the double-acting engines now under construction appears to be high, and Mr. Traill questions whether such high speed can be maintained in service conditions without undue wear and tear and consequent danger of breakdown.

Mr. W. J. Muller, in a paper giving *General Data on the Propulsion of Ocean-going Ships in Holland*, deals with reciprocating engines, steam turbines, and internal combustion engines. He points out that from the commercial point of view the efficiency of a Diesel engine installation entirely depends on the price of the fuel and the costs of upkeep and repairs as compared with steam plants. In Dutch practice double reduction marine turbines using superheated steam have a steam consumption of between 4.5 kilos. and 5.5 kilos. per shaft horse-power per hour. Recent investigations in Dutch steamships fitted with water-tube boilers have shown that the best results are obtained with boilers having large combustion chambers.

In the discussion Mr. Hammar, dealing with the application of the Ljungström turbine, claimed it to be the most economical of all turbines. The Atlas boiler had, he said, created attention recently and was now being designed for a rate of evaporation as high as 100 lb. of water per square foot of heating surface per hour at a pressure of 1500 lb. per square inch. It was difficult to say whether the Ljungström turbine could be used for marine requirements.

Engineer Vice-Admiral Sir Robert Dixon, discussing the paper by Mr. Belsey on electrical transmission, said that he saw no reason to change the opinion to which he had given expression on previous occasions that the disadvantages of electric transmission in warships were greater than the advantages. An important objection to electrical equipment was the weight and space occupied. Some case could perhaps be made out for the use of the Diesel-electric system for moderate powers in merchant ships, but the weight of that equipment also was such as to render it unacceptable in warships. Referring to the driving of auxiliaries electrically, the Admiralty had, he thought, initiated the use of the Diesel-electric system for that requirement. Everybody realised that for auxiliaries the electric drive was most economical. With regard to the future of the Diesel engine of the marine type, it seemed clear that it was only in a very early stage of development, and the advance which was being made in the evolution of the double-acting engine was only a beginning. The Admiralty was carrying out research work on Diesel engines at the present time. From the point of view of its use in warships it had the disadvantage of being a reciprocating engine and therefore apt to set up vibration. He had reached the conclusion that the geared steam turbine could not be replaced in Admiralty service by the reciprocating Diesel engine.

Mr. Belsey, referring to the criticisms as to the weight of electrical equipment, said that in the Navy the weight of turbine reduction gearing where high stresses had to be provided for was very considerable. On the question of transmission losses of Diesel-electric ships in cases with which he was acquainted the figure was not more than 11½ per cent. Alternating current was more efficient than direct current in marine service, and in the San Benito the alternating-current motor equipment gave an efficiency of 96.8 per cent.

Mr. Chalkley pointed out that in the Diesel-driven ship La Playa the propeller speed was about 100 revolutions per minute. If the installation had been of the direct Diesel type it would not be necessary to run the engine at a higher speed than 100, and the same propeller efficiency would have been obtained and the transmission losses associated with electrical plant eliminated. Comment had been made on the weight of Diesel machinery, but he would point out that in recent examples weight had been reduced in the case of double-acting engines to about 250 lb. per brake horse-power. In the case of the La Playa the weight was 312 lb. per shaft horse-power.

Lieut. B. R. Alexander (United States) desired to make it clear that electric transmission had not been generally adopted in the United States Navy and would certainly not be installed in destroyers for which the geared turbine had proved eminently satisfactory. It was admitted that the weights of electrical machinery were high, but that disadvantage was being gradually removed. From the point of view of the United States Navy, which in the case of war would have to meet an enemy at a great distance from his own shores, the advantage of electrical transmission was its great flexibility at low speeds. It might be that the decision of the British Navy not to make use of electric transmission was a sound one, and that the practice of the American Navy in that respect was not the right one.

Mr. H. S. Russell referred to the good effects of supercharging in Diesel engines, and contended that it did not result in a higher temperature, the final temperature depending on the ratio of compression. He was a believer in electrical transmission, which possessed a great advantage in giving good efficiency at different speeds. One difficulty with Diesel engine ships was the contamination of the oil fuel and lubricating oil, and he advocated the use of centrifugal oil purifiers.

Mr. A. A. Pollock commented on the advantage in connection with the electric drive of obtaining good speed variation in a heavy seaway. The equipment could have a speed load characteristic of any desired value, and it had been found in practice that that was a real advantage in marine service.

Mr. Alexander Gray, referring to the elimination of steam for the driving of auxiliary machinery on motor ships said it must not be overlooked that in passenger vessels steam would have to be retained, if only for the purpose of providing hot water for baths.

Professor E. Hubendick agreed with the contention that, while at first sight supercharging was not associated with an increase of temperature, one effect of supercharging was to burn more fuel in a given time, and that did have the effect of raising the mean temperature in the cylinder.

Concluding Sessions.

The conference terminated on Friday, July 11th, with two general meetings, at which a general review of sessional activities was made and consideration was given to future developments. There was a large attendance.

Mr. O. C. Merrill (Executive Secretary, Federal Power Commission) said he thought it would be generally agreed that the conference had done good work and had made contributions on the subject of Power of a character which had not been brought together on any previous occasion. These papers and the discussions which followed their presentation would be a source of reference to engineers and others for many years to come. Each country had brought its own contribution and the whole of the questions had been discussed in a spirit of confidence and co-operation. There had been general recognition of the fact that scientific knowledge was common property and should be used for the common purposes of mankind. The more widely that idea could be spread the greater difficulty there would be in setting in action, between the various people of the world, those disruptive forces which led to war. It was proposed to give consideration to the question of forming a national institution to further the objects of the first World Power Conference.

Mr. Hugo Hirst, who presided at the afternoon meeting, said that the organisation which was to be formed would constitute a guarantee that other conferences would take place from time to time and continue the work which had been started in London. The first conference had rendered useful service in its attempt to test the resources for the production of cheap power which the world offered. Cheap power meant cheap transport, and its employment should be followed by that reduction of manufacturing costs which was essential for the progress of the world at the present time. An extension of international trade would ensure the employment of a far larger number of people than were at present working in useful and peaceful occupations. The London conference was, however, something much greater than a meeting of engineers and scientists, as it had made a beginning with a task which would set the steps of the world towards peace. No doubt there would be difficulties in carrying out the desires and aspirations of the representatives of the many nations assembled in London, and legislation would be called for in different countries. This was, however, a democratic age, and if the people willed a thing, Government would give way and all obstacles would be overcome.

The resolutions which were passed asked each country participating in the conference to create and maintain a permanent National Power Committee, from which delegates would be appointed on an International Executive Committee, which would for the time being carry out the necessary work arising out of the conference. Another resolution recommended that the organisation which had convened the London conference should remain as the organisation during the transitional period. To the International Committee is to be assigned the duty of deciding on lines of policy and of fixing the time and place of the next World Power Conference.

The following general resolution was unanimously carried:—"That this Conference is of the opinion that the world's most crying need to-day is greater production and manufacturing activity among its peoples under conditions which will promote individual prosperity and happiness, and that this can be largely achieved by the fuller development of national power resources and by the establishment of the most economical means for the general distribution and utilisation of energy."

Addresses dealing with the work of the Conference and referring generally to the character of the task which is to be undertaken were delivered by representatives of the United States, Canada, Australia, New Zealand, South Africa, India, Italy, Austria, France, Denmark, Germany, Holland, Norway, Russia, Sweden, Belgium, Czecho-Slovakia, and Japan. It is understood that the next Conference will be held in Rome in 1927.

Delegates to the congress participated in the Kelvin centenary celebrations, and on July 14th they paid a visit to Birmingham, under the auspices of the Institution of Electrical Engineers, for the purpose of inspecting the engineering laboratories at Birmingham University and the Nechells power station. On July 15th a visit of inspection was made to the Underground Railways of London, delegates being entertained at luncheon by the directors of the company. The final entertainment of the London gathering was a conversazione, held on July 15th at the Institution of Civil Engineers, by invitation of the Councils of the Institutions of Civil, Mechanical, and Electrical Engineers. Many delegates subsequently took part in visits to the water power plants of France, Switzerland, Italy, and Scandinavia.

SIXTY YEARS AGO.

If a special providence watch, as it is said to do, over children, it would seem no less to intervene in the earlier stages of some of man's inventions. We cannot avoid the thought that had the three railway accidents which we very briefly recorded in our issue of July 22nd, 1864, happened to-day the results, one way or another, would have been much more serious than they were. In the first mishap the engine of an express passenger train on the Great Eastern jumped from the line "while going at the usual speed" and turned over down a bank, the coaches also being thrown off. Three days later, on the same railway, a tender axle of an engine drawing a parliamentary train broke, with what physical result, however, we are not told. On the same day on the North-Eastern an express train going at full speed ran off the line as a result, it was believed, of the breaking of the leading axle of the engine. Derailments of express passenger trains are to-day fortunately very rare, but if two occurred within four days, is it in the least probable that no passenger would be killed? Yet in the three accidents of sixty years ago only one life was lost, that of the fireman on the engine involved in the first mishap, all the passengers escaping with nothing worse than "a severe shaking." The impression of a special providence is, of course, wholly illusory, as is evidenced by a report elsewhere in the same issue of a terrible railway accident to an emigrant train in Canada. A swing bridge across the Richelieu River had been opened to allow some barges to pass, but the train, disregarding the danger signals, approached with speed unchecked and plunged into the open gap. The accident occurred in the dead hours of the night, and led to the deaths of at least eighty passengers. . . . In the course of a leading article on the corrosion of boilers it was stated that nearly all the boiler explosions investigated by the Manchester and Midland Boiler Associations were found to have been caused by internal or external corrosion. Even in locomotive boilers, which were then "exploding sufficiently often to cause considerable anxiety," furrowing along a seam was found to be the usual malady. We expressed the view that so far as corrosion was concerned wrought iron was the worst possible material that could be employed for a boiler, and doubted whether steel would prove superior. Copper was out of the question on the score of its scarcity and cost, and we accordingly recommended cast iron, a material presenting a good resistance to corrosion and second only to platinum in its power to withstand the effect of elevated temperatures. Cast iron boilers capable of resisting 1500 lb. to 2000 lb. per square inch were then actually in existence.

In the Canadian House of Commons notice was recently given by the Minister of Railways of the introduction of legislation providing for the construction of a railway viaduct on the water front at Toronto and the completion of new union termini. The total estimated cost is approximately 28,000,000 dollars, which is to be borne by the Canadian Pacific Railway, the Canadian National systems, the city of Toronto and the Harbour Board, under an agreement to be arranged. The project has been under consideration for the last ten years, and an agreement has now been reached between all the contracting parties for the completion of the work within five years.

A Ropeway for Explosives.

WE recently had an opportunity of exploring an overhead ropeway of unusual design, and although it is not of any very great extent as regards length, it involves so many peculiar features that the following brief account of its arrangement will undoubtedly be of interest to our readers, while the photographs reproduced in the engravings herewith and in our Supplement will help to give an idea of some of the difficulties which had to be overcome in designing the line.

The ropeway has been installed at the explosives factory of Cookes Explosives, Limited, at Penrhyndeudraeth, in North Wales, for the purpose of conveying materials from one to another of the several isolated huts where the various processes are carried on, and also for taking the finished materials to a magazine on the top of a hill. On reference to the engravings it will be seen that the site is very broken country; the factory is, in fact, spread over two adjacent rocky valleys, which are separated by a steeply rising ridge of rock. This ridge can be seen in the illustration of station E—see Fig. III. of our Supplement—surmounted by a large water tank.

With such natural difficulties to contend with any system of truck transport was ruled out of the question, although trucks would otherwise be very convenient, as the traffic has various destinations, and a ropeway is generally only associated with transport between two stations. The British Ropeway Engineering Company, Limited, of 34, Fenchurch-street, has, however, solved the problem of adapting the ropeway system to such circumstances,

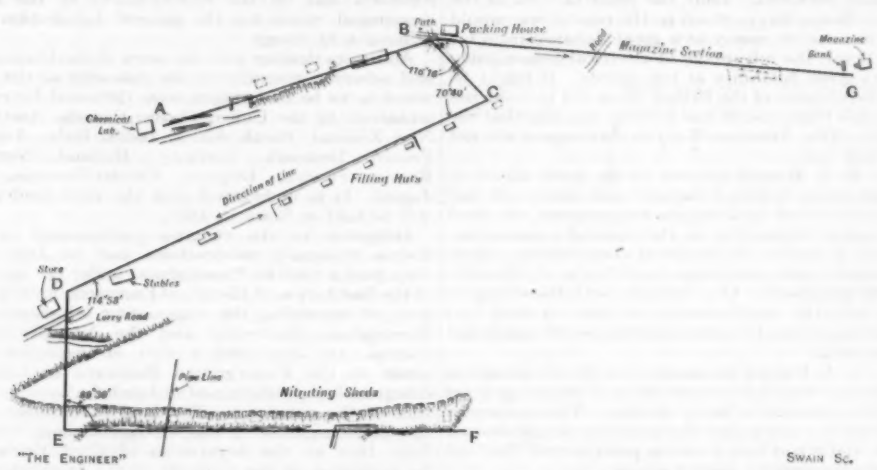


FIG. 1—GENERAL PLAN OF THE ROPEWAY

trolleys, and it will be seen that there are four wheels, in pairs alongside one another. The frames for the two pairs are connected together by links, and the upper links are extended to form the jaws of a clip for gripping the driving rope. The load is carried by a hanger attached to a pin fixed to one pair of wheels only. The wheels and clips, by the way, are of phosphor bronze, to meet the Home Office regulations, while the wheels are fitted with Skefko ball bearings, otherwise the constructional details of the trolley are fairly obvious from the drawing.

On reference to Fig. 2 it will be seen that with the load depending from the pin, on the right of the trolley, and carried by the left-hand wheels running on the rope, the jaws of the clips are pulled together to grip the driving rope. In these circumstances the right-hand wheels are, of course, hanging freely. If, however, the load be transferred to the right-hand wheels and the left-hand pair left unsupported, the clip will open and release the driving rope. By making provision to effect this transfer of the load automatically, and at the same time arranging to side-track the trolley, any carrier can be taken off the line without interfering with the others.

At each of the switch, or shunt, stations the main carrying rope is deflected downwards below the general trend of its direction, and its place is taken by a rail. The rail also has a dip, but not so pronounced as that of the rope, for a reason which will be explained later. Alongside the main rail there is the shunt rail, which curves out into the siding and then goes back to join the main line again. Both the entering and leaving curves of the shunt rail are hinged so that they can be brought into the operative position or swung out of the way to clear a "through" carrier. The entering hinged portion is operated automatically by the carrier itself, but the outgoing switch is worked by the man who has come to attend to the stopped box.

On the hanger of each carrier—see Fig. 3—there is a spindle A which works a catch B, by means of a cam, when the spindle is rotated through 90 deg. This catch is used to hold a bell crank C, or release it, according to the position of the spindle A. The catch is normally held up by a spring and the spindle is then in the position shown, with a trip arm D standing up vertically. The bell crank is also held up by a spring ready to receive the catch.

Just before the entry to a shunt station a stop is arranged in the way of the trip arm, which is consequently swung round to the horizontal position by the forward movement of the carrier. The catch B then locks the bell crank C in the raised position, and as the carrier goes on the wheel on the crank runs under an angle bar connected with the shunt entrance rail and swings it into the operative position. If the trip arm had not encountered a stop the catch B would have been held up, the bell crank would have been free to ride under the angle bar, as indicated by the dotted lines, and the shunt would remain open, so that the carrier would go on on the main line. The spindle A is provided with a number of notches, so that the trip arm can be readily put in any one of ten positions, corresponding with the separate shunt stations. The change can be effected in one or two seconds, and the attendant can consequently very easily dispatch a carrier to the station at which he wants the load delivered.

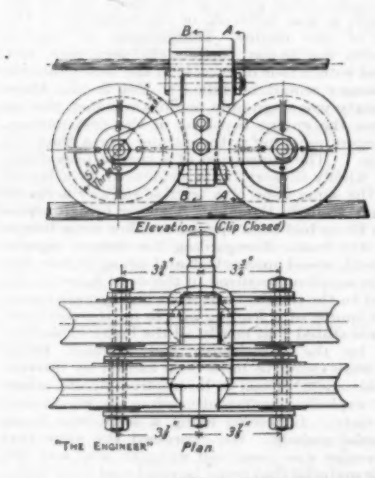
The shunt rail, when in the operative position, is in line with the right-hand wheels of the carrier trolley. Directly after the point at which these wheels run on to the shunt rail the main rail dips down, as already described, and the left-hand wheels consequently drop, the clip opens and the driving rope is released. The flanges of the left wheels are then clear of the main rail, and the clip has dropped below the driving rope, so that the trolley can follow the outward curve of the shunt rail. It runs into the shunt station and is checked by friction against a wooden fender.

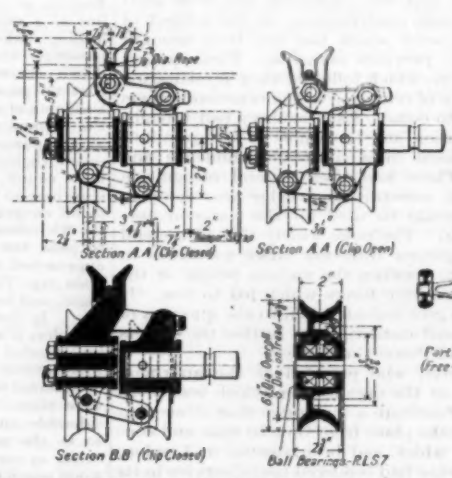
When the carrier has been unloaded, or loaded, the outgoing curve of the shunt rail is swung into position by hand, and the carrier is pushed on to it. As the shunt rail approaches the main rail both rails rise slightly towards the hauling rope, which is forced into the clip, and when the trolley wheels run off the end of the shunt the clip grips the rope and the carrier goes forward on the main line. Thus it will be seen if a carrier has been dispatched with the trip arm set for any shunt, it will run into that station automatically and remain there until attended to, while other traffic can continue on the main line. The shunts are made long enough to accommodate several carriers in order to guard against the contingency of a second carrier arriving in the station before the previous one has been sent away.

Reverting to the ropeway itself, a profile of which is given in Fig. 4, it has a capacity of from 8 to 10 tons per hour in loads of 2 cwt. each, while the speed of the carriers is 50 yards a minute.

The length of the main line is 945 yards with a total difference in height of 108ft., while the branch to the magazine is 219 yards long with a rise of 222ft. Fig. 4 gives profiles of both lines and shows all the important features on the route. It will be noticed that the section between stations B and C is carried by a gantry, instead of a rope, as it is only about 170ft. long, and it was not considered worth while to put in rope anchorages for this short distance. It will also be seen that in crossing the dividing ridge of rock, between stations D and E, a small cutting has been made. This plan was adopted, instead of carrying the rope right over the summit, in order to reduce the grip on the hauling rope necessary to overcome the steeper gradient and also to relieve the loading on the trestles.

The main carrying rope is 2½in. in circumference,





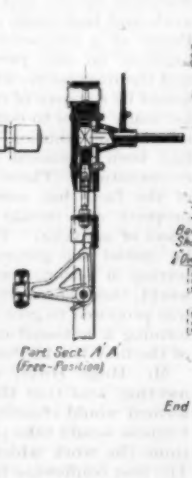


FIG. 2—ELEVATION, PLAN AND SECTIONS OF CARRIER TROLLEY

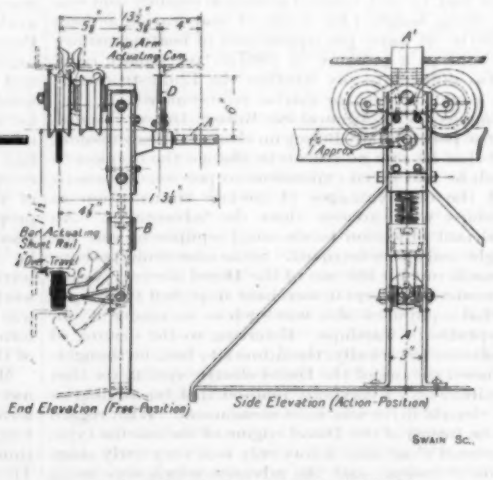


FIG. 3—HANGER OF CARRIER TROLLEY

and when we inspected the plant it had been running for some months with satisfaction to the owners.

On reference to the general plan of the line—Fig. 1—it will be seen that the ropeway has to serve a chemical laboratory, a packing shed, half-a-dozen huts and four nitrating sheds, while there is a branch running out to the magazine. It may be necessary to stop a carrier at any of the buildings, for loading or unloading, but obviously it would not be practicable to stop the whole line for this purpose, and an automatic system of switching the carriers out on to side lines has consequently been evolved, so that the stream of traffic is not interrupted by the stoppage of the carriers for loading. It may be as well to go on to explain this switching system before describing the ropeway itself, as its adoption has determined several of the features of the main line.

In Fig. 2 we give drawings of one of the carrier

and is of the half-lock type. It weighs 4.63 lb. per yard, and has a tensile breaking stress of 23.5 tons. The applied tension is 4 tons and is produced by long straining bolts at the anchorages. The hauling rope is a Lang's lay wire with a hemp core, 1⅜in. in circumference. It weighs 1.02 lb. per yard, and has a breaking stress of 6 tons, while the applied tension is 5 cwt.

The theoretical energy required to work the main line in the condition of the heaviest possible loading is 5.9 horse-power, while the corresponding amount for the magazine line is 2.5 horse-power. A motor of 20 horse-power has, however, been installed to give a good margin.

The most interesting station on the line, apart from the shunts already described, is that at B, where there are the packing sheds, the driving gear and the branch to the magazine. A plan view giving

the general arrangement and details of construction of this station is reproduced in Fig. 5.

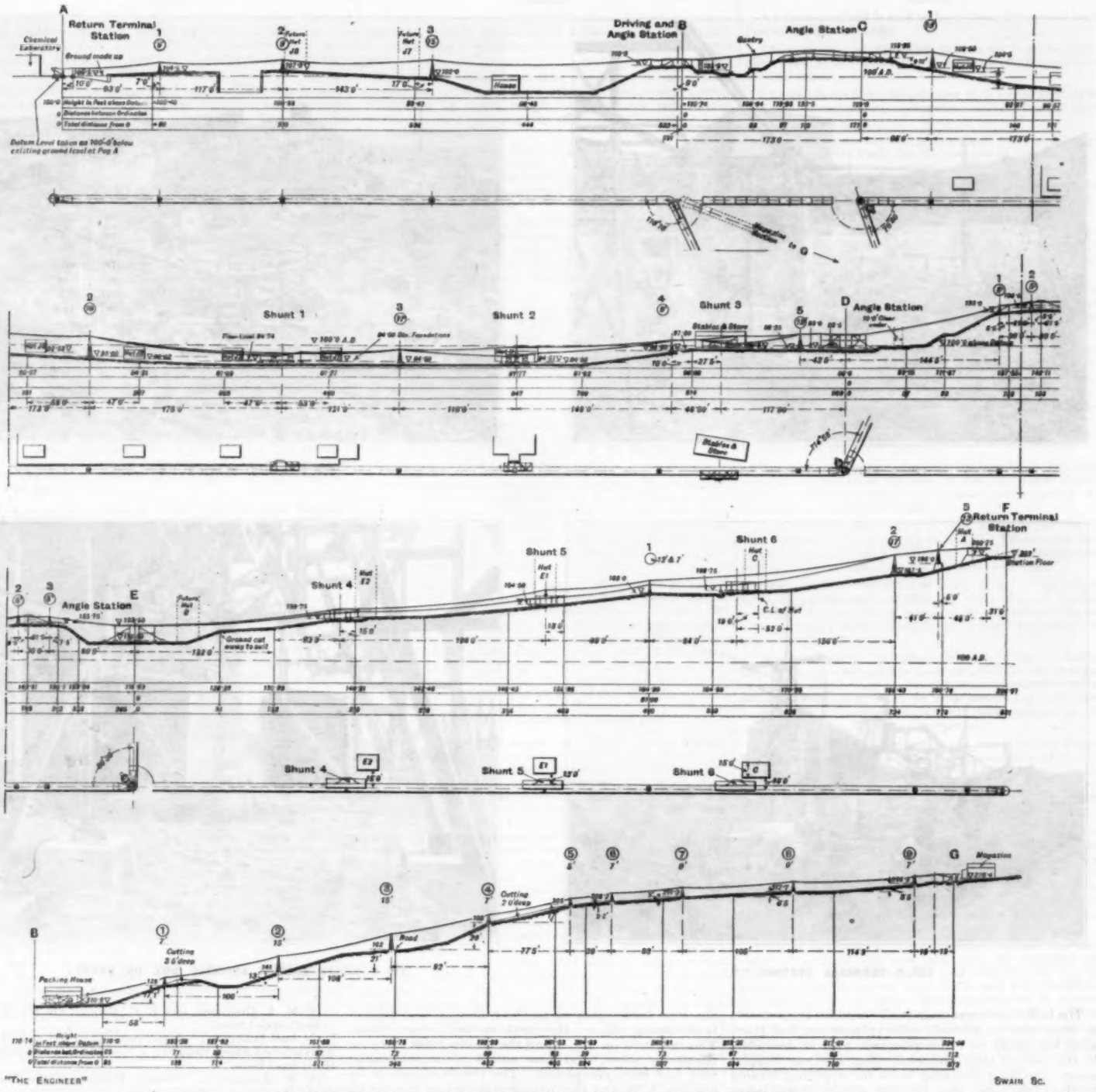


FIG. 4—PROFILES AND PLANS OF MAIN AND MAGAZINE BRANCH ROPEWAYS

The driving rope coming from station A takes a left-hand turn round a guide sheave, 24in. in diameter, at the angle of the framing. The left-hand turn is really only adopted in order to avoid having to bracket out the spindle for this sheave. The rope then goes away to the end of the main line, back to the sheave of the driving gear, over a tension pulley, round another guide sheave and on to A again. The tension pulley is mounted on a trolley which is pulled back by concrete weights hanging on a rope in the tower. The run of the rope for the magazine line is very similar except that the route is straight. Separate driving sheaves, it will be noticed, are provided for the two ropes.

The motor of the driving gear is connected with the driving sheaves by chain, belt and bevel gearing, which reduces the speed from 950 revolutions per minute down to 24 revolutions per minute. Both the bevel pinions can be slid along the shaft so that either sheave can be put in or out of action. The sheaves are 24in. in diameter, and the rope makes one complete turn round each of them.

Two switch rails are provided at station B for making a connection between the branch and main lines. These rails are shipped by hand, when required, and the carrier pushed over, but in the case of light occasional traffic the loads are generally transferred from one carrier to another by hand. This illustration also shows the guard rails which are provided at the stations for preventing the carrier boxes from fouling the stanchions if they happen to swing. The sheaves at the angle stations and the terminals are 6ft. 9in. in diameter. At the terminals a carrier can be stopped by raising a rail, by hand, to carry the weight in the same way as the shunt rail. To send the carrier on again the hauling rope is pulled down into the clip again by a hand-operated roller fixed on a long lever.

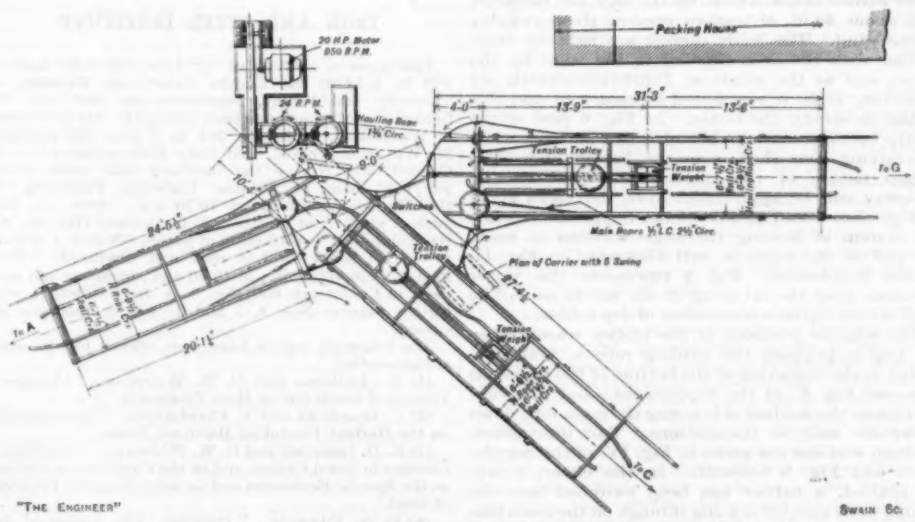


FIG. 5—ARRANGEMENT OF STATION "B"

At each of the stations on the line there is a push button with which the driving motor can be stopped in case of emergency. At the same time a coloured light is switched on in the driving station, and until this signal is cancelled by the man who stopped the rope, the attendant cannot restart the motor. There is also an extensive system of automatic telephones between all the stations on the ropeway.

ROPEWAY AT PENRHYNDEURAETH EXPLOSIVES FACTORY

FIG. 6—DRIVING STATION "B"

FIG. 7—ANGLE STATION "C"

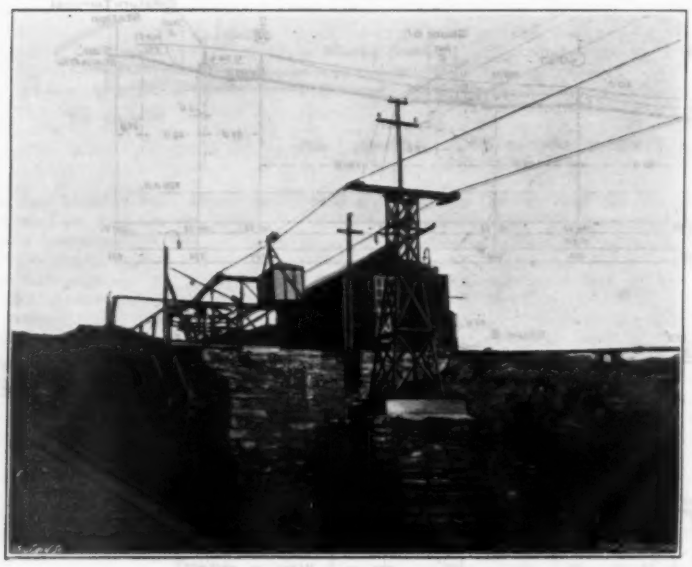


FIG. 8—TERMINAL STATION "F"

FIG. 9—SHUNT STATION SHOWING BOX ON SHUNT

The half-tone engravings really need little comment, as they are, in general, self-explanatory, but there are a few points to which reference may be desirable. In the view of the terminal A—Fig. I. of our Supplement—the long straining bolts for applying tension to the main ropes can be seen sloping down below the rail, while the hand operated roller, already referred to, for pulling the hauling rope into the carrier clip is shown behind the guide pulley in the foreground. This view also gives a good impression of the carrier boxes, which, by the way, are ballasted with about 40 lb. of lead to prevent them swaying in the wind. The loads carried are light by comparison with the area exposed to the wind by the boxes, and as the winds at Penrhyndeudraeth are often very high, it was found necessary to add this ballast to steady the boxes. In Fig. 6 part of the gantry between stations B and C can be seen, while the driving gear shed is in the background. The rugged nature of the country traversed by the cableway can be appreciated from the views given in Figs. 7 and in Fig. III. of the Supplement, while the system of bracing the angle stations to resist the pull of the ropes is well illustrated in Fig. II. of the Supplement. Fig. 8 represents the upper terminus, near the nitrating sheds, which, as will be seen, is built up on a foundation of dry rubble.

The relative positions of the trolley wheels when the clip is gripping the hauling rope is well illustrated in the engraving of the bottom of the magazine line—see Fig. V. of the Supplement—and this view also shows the method of bringing the main rope down under the rails at the stations. Two illustrations of shunt stations are given in Fig. IV. of the Supplement and Fig. 9 herewith. In the latter, it will be noticed, a carrier has been switched into the shunt, while another is going through on the main line, On reference to Fig. VI. of the Supplement it will be seen that on the end of the cross arm, outside the roller for the hauling rope, there is a bent piece of flat steel. The object of this piece is to guide the rope back again on to the roller, in the event of it dropping off, as the next carrier comes along. The ironwork on the top of the trestle is for carrying telephone wires, and was added after the cableway had been completed. The trestle shown is on the line A–B, and the driving station can be seen on the left, while one of the huts between C and D is shown on the right.

IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute will be held at the Empire Exhibition, Wembley, on Thursday and Friday, September 4th and 5th. The following programme has been arranged. On the evening of Wednesday, September 3rd, at 9 p.m., the president, Sir Wm. Ellis, G.B.E., and Lady Ellis, supported by the Council, will receive the members and ladies accompanying them at Princes' Galleries, Piccadilly. On the Thursday morning, at 10.30 a.m., there will be a general meeting of members in Conference Hall No. 3 at the Exhibition. A selection of papers—Nos. 6, 1, 4 and 9, in the list below—will be read and discussed. On the Friday, September 5th, at 10.30 a.m., members will again meet in Conference Hall No. 3 at the Exhibition, when further papers—Nos. 8, 7 and 2—will be read and discussed.

The following papers have been offered for discussion at the meeting :—

(1) L. Aitchison and G. R. Woodvine, "Changes in Volume of Steels during Heat Treatment";

(2) C. Benedicks and V. Christiansen : "Investigations on the Herbert Pendulum Hardness Tester";

(3) E. D. Campbell and G. W. Whitney : "The Effect of Changes in Total Carbon and in the Condition of Carbides on the Specific Resistance and on some Magnetic Properties of Steel";

(4) C. A. Edwards : "Pickling : The Action of Acid on Iron and Steel, and the Diffusion of Hydrogen Through the Metal";

(5) J. Newton Friend and W. E. Thorneycroft : "Examination of Iron from Konarak";

(6) M. A. Grossman and E. C. Bain : "On the Nature of High-speed Steel";

(7) Axel Hultgren : "Improvements in the Brinell Test on Hardened Steel, including a New Method of Producing Hard Steel Balls";

(8) W. Rosenhain : "Present Position of the Theories of the Hardening of Steel"; and

(9) F. C. Thompson and W. E. W. Millington : "The Effect of Free Surfaces on the Plastic Deformation of Certain Metals."

PRIZE COMPETITION FOR BRIDGE PLANS.

HIS MAJESTY'S Consul-General at Rotterdam—Mr. E. W. P. Thurstan, C.M.G.—informs the Department of Overseas Trade that the municipality of Rotterdam has announced its intention to hold an international prize competition for plans for the reconstruction of the Koninginne Bridge, which spans the narrower of the two branches of the river Maas encircling Noordereiland in the city of Rotterdam. Mr. Thurstan has forwarded for inspection by British firms interested a copy of the official programme, setting out the conditions of the competition. The competition is in no sense a call for tenders for the construction of a new bridge, but is instituted for the purpose of obtaining plans which could be utilised for the purpose of constructing a bridge. This does not apparently preclude firms which build bridges from sending in plans. The first prize offered amounts to the sum of 10,000 guilders. It is suggested that British firms, which might be interested at a later date in tendering for the construction of the bridge, might consider entering for the present competition, as the tender of the successful firm would probably receive special consideration, despite the fact that it is stated that the municipality recognises no obligation in this respect. Plans may be drawn up in English. United Kingdom firms interested may apply by letter to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1 (reference A.X. 1169), for a loan of the documents, which are in Dutch, and which will be lent in order of application.

Railway Matters.

A DESTRUCTIVE fire broke out at the London, Midland and Scottish Railway Works at Stoke-on-Trent on the afternoon of July 12th. Two locomotive sheds were destroyed, and a large quantity of timber and several locomotive engines were damaged badly.

THE Melbourne goods yard of the Victorian Government has fifty-two tracks in its main section and is capable of dealing with 3500 to 4000 trucks a day. Twice last year it did half as much again, as on January 17th it dealt with 6526 wagons and on February 1st with 6497.

IT is stated in the *Great Western Railway Magazine* that the Great Bear engine, No. 111, went recently into the shops at Swindon for general repairs, which include new cylinders and a new boiler, and arrangements are being made to reconstruct it so that it will be similar to the "Castle" type.

ASSINIBOIA, Alberta, is to be headquarters for the constructive engineer for the new branch line of the C.P.R. to run to Amulet on the Weyburn-Lethbridge line in a northwesterly direction to Dunkirk on the Moose Jaw-Assiniboia line. It is expected that 25 miles will be completed and turned over for operating this season.

WHEN mentioning, on June 13th, that Mr. Heywood, of Inverurie, was succeeding Mr. Chalmers at Cowlairs, we suggested, as no successor to the former was announced, that the works at Inverurie might be closing down. We note now, however, that Mr. L. Hyde, of the Hull and Barnsley section, goes to Inverurie as works manager.

THOSE signalmen who are members of the National Union of Railwaymen intend to set up a union of their own, to be known as the Union of Railway Signalmen. One of the three unions that made the N.U.R. was a Pointsmen's and Signalmen's Society; the other two were the Amalgamated Society of Railway Servants and the General Railway Workers' Union.

THE proposed extension of the Ashover Light Railway and its utilisation for passenger as well as goods traffic formed the subject of an inquiry held by the Ministry of Transport at the Chesterfield Memorial Hall on July 11th. The Commissioners were Mr. Alan Erskine and Mr. T. L. Patterson. Mr. Erskine promised to report to the Ministry in favour of the Order.

IN this column of our issue of April 6th, 1923, attention was drawn to the fact that the rolling stock on the Metropolitan District Railway bears no indication as to its ownership. As this is a contravention of Sec. 120 of the Railway Clauses Consolidation Act, 1845, it is interesting to note that the omission apparently is being met by the cars being lettered "Underground."

THE spacing of the automatic signals on the Central London Railway is being rearranged and, when completed, will allow the present thirty trains per hour to be increased to forty per hour. When the Central London was opened the time occupied in running from Shepherd's Bush to the Bank was from twenty-eight to thirty minutes. It is now twenty-two minutes and may yet be twenty minutes.

THE signal-box at Tattenham Corner, on the South-Eastern section of the Southern Railway, was completely destroyed by fire last week. As the box is only used on the occasion of races at Epsom, there was no one on duty at the time. It is assumed that the very brilliant sunshine at the time led to the glass in the windows causing some substance inside the box to catch fire. As the cabin was 125ft. long, the replacement of the locking frame point and signal connections and the block instruments will be an expensive matter.

THE construction of the first electric locomotive for the Detroit, Toledo and Ironton Railroad, owned by the Ford Motor Car Company, is about to be commenced. The engine was designed by engineers of that company to utilise high-tension power from an overhead circuit and to carry its own transformers and rotary converter, thereby obtaining the economies of both a direct and alternating-current supply. The new locomotive will be 117ft. long, weigh 340 tons, and have a tractive effort of 200,000 lb. It is designed especially to handle heavy trains of coal.

AN underground railway system on the latest European model will, says *Indian Engineering*, not be the only attraction of Bombay in the near future. Within a week of the announcement that the Government has been engaged in boring operations for the proposed underground railway on the B.B. and C.I. suburban line, has come another referring to the novel changes undertaken by the Great Indian Peninsular Railway Company at Victoria Terminus. If the company's scheme fructifies, the suburban railway trains will be run by electricity instead of, as now, by steam power.

WHEN giving evidence before the New South Wales Public Works Committee concerning the proposed Tempe-East Hills and the Bankstown-George's River railway lines, Mr. J. J. C. Bradfield, chief engineer for metropolitan railway construction and Sydney Harbour bridge, stated that the scheme outlined provided for electric railways on both lines. The track mileage of the Tempe-East Hills line would be 15 miles 7 chains, and the route mileage 10 miles 58 chains. Provision would be made for ten stations, including a terminal station at East Hills. The estimated cost was £493,049, averaging £45,922 per mile.

THE recent addition to the night expresses to Scotland reminds us that no longer is there the competition in speed between the East and West Coast routes that there used to be. This further reminds us of the serious derailment that occurred to one of the fast night trains on July 13th, 1896. That train consisted of seven coaches, including two sleeping cars, and was drawn by engines Shark and Vulcan. It ran non-stop from Wigan to Carlisle, and was allowed 112 min. for the 105 miles, or an average speed of 56¼ miles per hour. Neither driver had made the run before, and both evidently were anxious not to lose time. Consequently, they ran through Preston at about 50 miles per hour, instead of the prescribed 10 miles per hour, and the whole train was wrecked at the north end of the station. As only one passenger was killed, the personal results were much more fortunate than in a similar derailment at Salisbury on July 1st, 1906, in which twenty-four passengers and four servants were killed.

Notes and Memoranda.

ACCORDING to the *Engineering News-Record*, it is proposed to erect in Philadelphia a garage for 10,000 cars. It would have twenty floors above and three below street level.

IT has been discovered that a mixture of aluminium powder and sodium silicate solutions can, under certain conditions, be made which forms a very satisfactory weather-proof paint, capable of resisting abrasions to a remarkable extent.

THE Niagara Falls Power Company has constructed a model of the Falls to a scale of 1 to 100, to demonstrate the scenic effect on the Falls by varying the amount of water used for power purposes. The water for the model is supplied by pumping.

IT is claimed that a record was established in Canada when the No. 3 blast-furnace of the Algoma Steel Corporation turned out a total of 20,123 tons of basic iron. It is a 500-ton furnace, but had an average output in May of 682 tons a day. The biggest cast was 755 tons in one day.

IT is said that a permanent paint, which is absolutely acid and alkali proof, capable of withstanding without detriment any temperature between zero and 500 deg. Fah., able to be rendered quite non-inflammable, and cheaper to produce than any other paint now in use, has been prepared from a tar basis.

FURTHER development of the mercury vapour turbine is foreshadowed in an article in *Mechanical Engineering*, in which Mr. Emmet says that it is proposed to construct a new boiler for working at a pressure of 70 lb. per square inch, as against 35 lb. in the case of the Hartford plant. A three-stage turbine is also to be built.

AT the annual meeting of the Canadian Trent Waterways Development Association, Mr. G. K. Fraser emphasised the importance of urging the Government to complete the Trent Canal by finishing, at least, one lock on the Severn Division of the canal. The report for the year showed receipts for the year as 1603 dollars, with disbursements of 1535 dollars.

WHAT is said to be the largest electrically propelled passenger ship in the world is in course of construction for the Matson Line of San Francisco. The equipment will consist of two Curtis steam turbines directly connected to two 12,000 horse-power alternating-current generators, which will supply electricity to operate two 10,000 horse-power synchronous motors, each connected with a propeller shaft. The plans for the new liner call for a speed of 21 knots, which will enable the vessel to make a round trip between San Francisco and Honolulu every fourteen days, including two and a-half days in each port.

IN the course of a paper on "Mechanically Perfect Electrolytic Nickel," presented at the April meeting of the American Electro-chemical Society in Philadelphia, Mr. Charles P. Masden remarked that hydrogen in itself is not the principal cause of electro-nickel trouble. Organic materials and iron are far more important, and their effect depends upon their condition. Soluble organic material is the principal cause of lack of ductility. Organic colloids cause failure after heating the metal, and large organic particles may cause pitting during cathode deposition. The use of hydrogen peroxide in the bath is claimed to be a cure for pitting, and has other beneficial effects.

SEEPAGES of oil and liquid asphalt and veins and deposits of solid asphalt are found throughout the whole length of Cuba in all the six provinces. The best known and most developed of the solid asphalt mines, writes the Acting British Consul-General at Havana, is situated near the port of Mariel, some 35 miles west of Havana. It is estimated that 70,000 tons of asphalt had been mined and shipped from Mariel prior to 1914. During the war operations were suspended, and were not renewed until 1919, when one of the veins was attacked by a shaft and underground galleries at a depth of 200ft. At this depth the vein has so far been opened up for a length of 700ft., varying from 25ft. to 35ft. in width. It has been traced on the surface for over 3090ft. by open pits, and at one point shows a maximum width of 70ft. A bore-hole on the vein showed asphalt at 450ft.

THE type light lorry which will be acceptable under of the new subsidy scheme of the War Department will now differ very little from the light char-à-banc and 30-cwt. and 2-ton lorries of the latest British-made types in commercial use. Although the specification describes a pneumatic-tired vehicle with 38in. or 34in. by 7in. giant tires, the subsidy may be granted in connection with vehicles which normally operate on solid or twin pneumatic tires, but are so designed that a quick change over to the War Department standard pneumatic tires can be effected when desired. Provision is made for electric lighting, a speedometer, and a power-driven tire pump, but these items need not necessarily be fitted to the vehicles accepted for subsidy. Copies of the specification and particulars of manufacturers building vehicles which comply with it can be obtained from the Chief Inspector of Subsidised Transport, Caxton House, Tothill-street, Westminster, S.W. 1.

A NEW design of nozzle for bottom-pour ladles, designed and patented in the United States, has the hole through the nozzle brick derived from the shape of the compound tube used in hydraulics. This type of tube for discharging water is one which converges to the minimum diameter, continues cylindrical for a short distance, then gradually diverges. The advantages claimed with such a nozzle are:—(1) A slightly larger volume of metal can be poured through this type than through a cylindrical one of the same minimum diameter. The stream is uniform, and there is less of a tendency to spray, especially with partial openings of the stopper. (2) The tendency to freeze up in case the metal is not superheated sufficiently is lessened, owing to the short length of the least diameter compared with the cylindrical type and to the divergence of the lower part. (3) The divergence feature facilitates reopening the nozzle in case of a freeze up. (4) It can be produced at low cost and substituted for the present standard nozzle without material change in the ladle.

Miscellanea.

A LARGE coalfield is said to have been discovered on the Franco-Belgian frontier.

AN exhibition of American inventions is to be held in New York at the American Institute from December 8th to 13th next.

THE receipts of the Manchester Ship Canal for the first half of this year showed a decrease of £26,697, as compared with last year.

LOUD speakers are being installed on the Nord-Sud Railway trains in Paris, for the purpose of announcing the next station to the passengers.

IT is estimated that the cost of reconstructing the bridge between Dunston and Teams will cost £20,000, half of which will be paid by the Gateshead Town Council.

THE Australian Government has just placed an important order for two automatic telephone exchanges for Sydney equipped for 12,000 subscribers, the value being nearly £300,000.

A ROADS BILL was introduced by Mr. Gosling on the 15th inst., and given a first reading. One of the sections provides for the Ministry of Transport to hold inquiries into road accidents.

THE Birmingham Electric Supply Department has decided to equip six boilers for burning pulverised coal. A water screen is to be used to prevent the emission of dust from the chimneys.

A GRAIN elevator is to be put up at Edmonton, Alberta, at a cost of 1,000,000 dollars. It is to have a capacity of 2,000,000 bushels, and it is hoped to have it finished in readiness for the next crop.

IT is proposed to put up works at Burnie, in Tasmania, for making iron from the ores of the Hampshire district. Railway communication exists, and electric power and limestone are available locally.

THERE is a scheme on foot in New York for the erection of a museum of engineering industry. Efforts are being made to raise a fund of 10,000,000 dollars for the purpose, and 1,000,000 dollars has already been collected.

THE new Ulster collieries at Coalisland, Co. Tyrone, are to be opened to-day, the 25th, by the Duke and Duchess of York. The coal found is said to be of good quality, and it is expected that it will last for forty years with an annual output of 400,000 tons.

THE harbour at Kingston, Ontario, is to be further improved. A contract has been awarded for the dredging of a 14ft. channel up to the Canadian locomotive works' wharf. There is a ledge of rock which has prohibited heavily coaled vessels discharging their cargoes at this wharf, and this ledge is to be removed.

IT is reported that a conference is being held at Prague for the purpose of considering the possibility of de-controlling the coal trade in Czecho-Slovakia. New regulations will be published shortly. It appears likely that the prices of coal will no longer be fixed by the Government, but will be left subject to the law of supply and demand.

A FURTHER stage in the development of the Cast Iron Research Association was reached a few days ago when the Association formally took possession of its own laboratories in Guidford-street, Birmingham. The capacity of the Association to deal with its work will be greatly increased by these laboratories, but it is not intended to abandon the policy of having investigations conducted in prominent University laboratories and in the works of members.

DURING the quarter ended March 31st last the total value of imports into Australia from all countries was £36,507,484, which compares with £37,206,966 for the quarter ended December 31st, 1923, and £33,776,258 for the first quarter of 1923. The improvement in imports from this country which took place in the final quarter of last year has not been maintained, the value having declined by £1,100,000. German and Japanese imports decreased slightly, while those from Canada and the United States of America registered increases.

A SPECIFICATION just issued by the B.E.S.A. covers four types of magnetos used for internal-combustion engines—excluding those for aircraft purposes. The dimensions standardised are those which affect the interchangeability of magnetos as a whole. Recommendations are also made in regard to the width of the engine coupling, flange mounting, and the sparking position in relation to the keyway in the tapered end of the armature spindle. Full particulars are given for the plug and ring gauges for checking the taper in the magneto coupling and on the armature spindle.

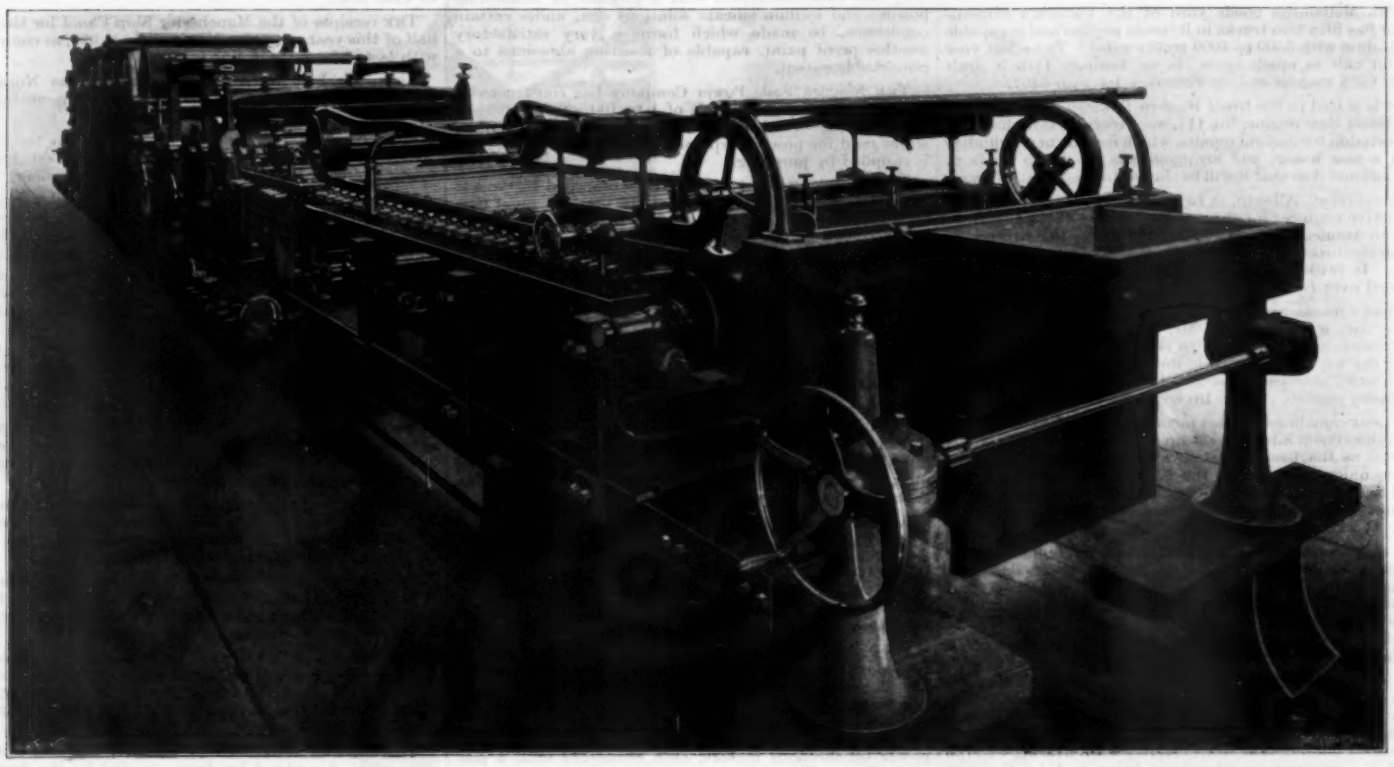
IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in June amounted to 607,800 tons, compared with 650,900 tons in May and 692,900 tons in June, 1923. The number of furnaces in blast at the end of the month was 185, a decrease of 6 since the beginning of the month and the lowest number in blast since January, 1923. The production includes 181,100 tons of hematite, 222,200 tons of basic, 144,200 tons of foundry, and 31,600 tons of forge pig iron. The output of steel ingots and castings amounted to 651,500 tons, compared with 809,700 tons in May and 767,700 tons in June, 1923.

PLANS for the construction of storage dams on the Ste. Anne de la Perade River, the Rivière du Loup and the Rivière du Nord, are now under review by the Quebec Running Streams Commission, and preliminary work may start early next spring or in the autumn. The damming of the Ste. Anne River will cost about 500,000 dollars, of the Rivière du Loup 300,000 dollars, and of the Rivière du Nord 300,000 dollars. By the construction of these dams the flow of the waters will be so regulated that the industries which benefit will not be affected by the winter. While these works have been under consideration, the 2,000,000 dollar dam at Kenogami has progressed so satisfactorily that it will, it is anticipated, be finished late this autumn. Through the damming of the Chicoutimi and des Sables rivers the flow of these two watercourses will be regulated and the power increased from about 50,000 to 150,000 horse-power.

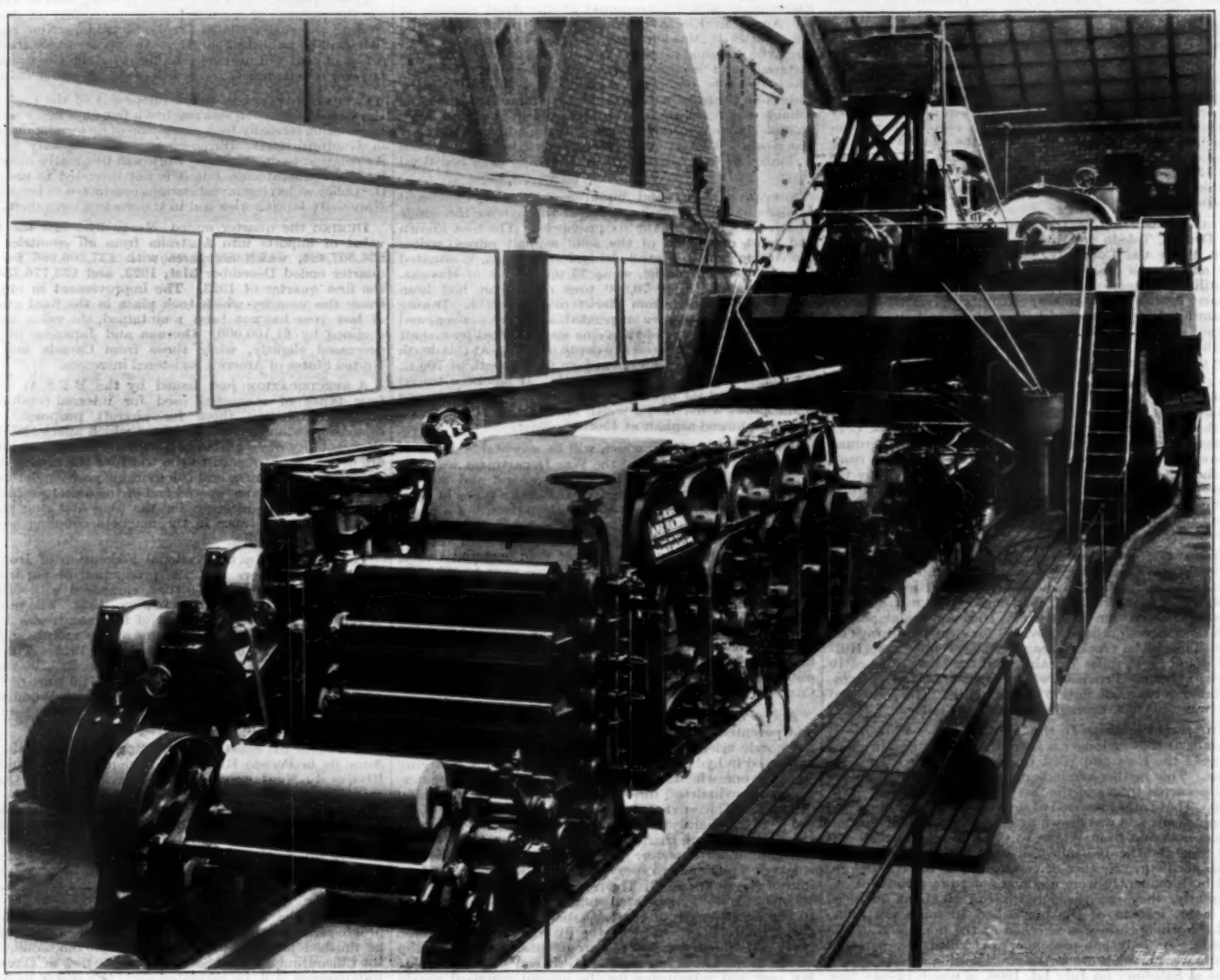
EMPIRE EXHIBITION—MODEL PAPER-MAKING MACHINE

CHARLES WALMSLEY AND CO., LIMITED, BURY, LANCS., ENGINEERS

(*For description see page 95*)



VIEW OF MACHINE FROM WET END



DRY END OF THE MACHINE AND GENERAL VIEW OF THE EXHIBIT

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By arrangement with Reuter's Engineering Service, The Engineer contains the latest news from all parts of the world which is likely to be of interest to engineers.

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SUPPLEMENTS—INDEX TO VOL. CXXXVII. AND A TWO-PAGE PLATE OF AN OVERHEAD ROPEWAY WITH SIDINGS.

THE ENGINEER.

JULY 25, 1924.

The "Standardised" Light Cruiser.

IN the course of the year five cruisers of the new "County" class are to be laid down for the Royal Navy. According to official statements in Parliament, they will conform in size and armament to the type standardised by the Washington Treaty; that is to say, they will displace about 10,000 tons and carry guns of 8in. calibre. Ships of the same general type are already being built or are projected for the navies of the other Treaty Powers. Japan has begun work on the Myoko, and between now and the end of next year will lay down three further units of that class. Of 10,000 tons displacement, they are reported to have machinery developing 120,000 shaft horse-power, and will mount eight 8in. guns in twin turrets. Four smaller ships are already under construction in Japan, viz., Kako, Furutaka, Kinugasa, and Aoba. In them the displacement is limited to 7100 tons. No machinery details are available, but it is known that the ships will have the very powerful armament of six 8in. guns. The French programme provides for the construction of six 10,000-ton cruisers during the next few years, an armament of eight 8in. guns being indicated. Italy is laying down this year the cruisers Trieste and Tarent, also of 10,000 tons, but in conformity with Italian tradition the gun power of these vessels will be very formidable in proportion to their size, each mounting ten 8in. guns in two triple and two twin turrets. Finally, the American Navy Bill, which has not yet become law, authorises the construction of eight cruisers, to displace 10,000 tons apiece and to have eight 8in. guns.

In view of the restriction on tonnage, the high speed which will certainly be aimed at, and the considerable weight allotted to armament, it will be difficult, if not impossible, to equip any of these vessels with side armour strong enough to resist projectiles even of medium calibre. Their protection is therefore likely to resemble that of most of the fast cruisers now in service, which are plated amidships with 3in. high-tensile steel, in addition to 1½in. protective decks over the machinery and other vulnerable parts. When this system came into vogue, the 6in. gun was the heaviest piece carried by foreign ships of recent date, and against shells of this calibre the combination of 3in. side armour with decks of the given thickness was doubtless reasonably effective. But with the universal adoption of the 8in. gun, which is now impending, the new cruisers will need some stouter form of protection if they are not to be exposed to damaging hits, even at long range. The problem of how to confer such protection without unduly sacrificing armament or speed is one that will tax the ingenuity of naval constructors to the utmost; in fact, we do not see how it can be solved on a really satisfactory basis. If the naval demand for speed and hitting power is to be met—say, 33 knots and eight 8in. guns—there will be very little margin left for armour. Probably therefore ships built on the "Washington" model will be deficient in resistance to gunfire, a failing which will compel them to fight at long range, especially as their high-velocity 8in. guns should be effective up to maximum visibility. It is not altogether a misfortune, from our point of view, that cruisers of the new type should be too costly to permit of their rapid multiplication. If foreign navies were able to build them in large numbers, our present fleet of cruising ships would soon become obsolete, consisting as it does for the most part of ships under 5000 tons, which mount nothing heavier than the 6in. gun. For the time being we have only four craft which in size and power come within measurable distance of the Washington standard. They are the Hawkins, Vindictive, Frobisher and Effingham, of 9750 tons, mounting seven 7.5in. guns apiece. The first two have machinery developing 60,000 shaft horse-power for a speed of 30 knots. In the second pair the figures are increased to 70,000 shaft horse-power and 31 knots. These ships were notable for the re-introduction of the 7.5in. gun, which had been in abeyance for about twelve years previous to their laying down. It was a calibre unknown in the British Navy until we acquired from Chile in 1903 the two battleships Swiftsure and Triumph, each of which carried fourteen 7.5in. guns in the secondary battery. Apparently it gave satisfaction, for guns of the same calibre were selected to arm the later "County" cruisers, and subsequently the heavier ships of the "Warrior" and "Defence" class. It had a high rate of fire and good armour-piercing properties, besides a considerably longer range than the 6in., which had hitherto been deemed the cruiser gun *par excellence*. The Vickers model 7.5in. 50-cal. piece, built in 1902, proved capable of firing five aimed rounds in 31 seconds, equivalent to eight rounds a minute. The most powerful mark of this calibre now listed in the Elswick ordnance tables has a muzzle velocity of 3000 foot-seconds, and can be worked at the rate of six rounds a minute. All British 7.5in. guns fire a projectile weighing 200 lb. Weapons of this weight and power should have sufficed, one would imagine, for most of the tactical requirements a cruiser is expected to fulfil. At the same time, we are inclined to think the Admiralty has done well to select 8in. guns for the new cruisers, seeing that so many ships now being built or projected abroad are designed for that armament. It is an old-established and very sound principle in the British Navy to build only such ships as shall be equal in fighting power to contemporary foreign craft of a similar class. Thus, when the Washington Conference agreed to restrict the armament of future capital ships to 16in. guns, and that of future cruisers to 8in. guns, it followed, almost as a matter of course, that the next vessels laid down for the British Navy would be armed in accordance with this ruling, despite the fact that both calibres were new to our service. It is close upon forty years since British ships armed with 8in. breech-loading guns were built. They were the four protected cruisers, Forth, Mersey, Severn, and Thames, launched in 1885–86. They were of 4050 tons displacement, with a speed of 16½ to 17 knots. Each mounted an 8in. 15-ton gun at the bow and stern, with ten 6in. on the broadside. The big gun weighed 15 tons, it had a length of 29.6 calibres, and its 210 lb. projectile, endowed with a muzzle velocity of 2150 foot-seconds, was capable of perforating 14½in. of wrought iron at 2000 yards range. It was therefore a weapon of formidable power for those days, but for some reason it failed to win popularity, no other vessels being armed with it. Several years later an improved 8in. model, built on the quick-firing system, came into favour with certain foreign navies, and formed the main armament of many cruisers constructed in England for the South American Republics and Japan. Many United States cruisers were also armed with guns of the same calibre. While there are, of course, no details to hand of the 8in. guns with which our new cruisers are to be equipped, various models of this calibre appear in the ordnance lists published by two of the great British manufacturing firms. Vickers Limited show an 8in. gun of 48.52 calibres, weighing only 14 tons 3 cwt., or less than the standard 7.5in. mark. The projectile of 247.4 lb. has a muzzle velocity of 3000 foot-seconds. Sir W. G. Armstrong, Whitworth and Co. list two marks of 8in. gun, 45 and 50 calibres

respectively, both discharging 250 lb. shell. The first gun weighs 18 tons, the second 20.4 tons; the respective muzzle velocities are 2845 and 3000 foot-seconds.

Exceptionally powerful broadside fire in proportion to displacement promises to be the most striking feature of cruisers built to the Washington standard. If a 10,000-ton ship of this type is armed, as it probably will be, with eight 8in. guns, it will discharge at each full broadside 2000 lb. of metal. Assuming four aimed rounds per minute to be the probable rate of fire in action, the ship would be hurling more than 3½ tons of shell at the target every minute, a volume of fire greatly exceeding that of which the average pre-Dreadnought battleship was capable. Cruisers of this hard-hitting type seem to be cast for a leading *rôle* in the naval wars of the future. Upon them will fall the brunt of the surface fighting, since the capital ships, limited in number and impossible to replace, will be too valuable to be risked, save in the last resort. If the Admiralty's construction programme is maintained by successive Governments, fifty cruisers of the 10,000-ton class will be built during the next ten years. This scheme, however, makes no allowance for any sudden expansion which the cruising fleet of a foreign Power may undergo in the interim. Our building policy must be governed, as heretofore, by the concurrent development of other navies. To defend our vast floating trade, we require, and probably shall always require, a large fleet of ocean cruisers, not inferior, ship for ship, to the best types serving under other flags. Thanks to the Washington Treaty, we need apprehend no revival of that frenzied competition in tons and guns which developed in the closing years of the last century between this country on the one hand and France and Russia on the other, and led to the building of monster cruisers which gave no adequate return in fighting power for the high cost of their construction and maintenance. The five principal naval Powers have mutually agreed to accept a limit of 10,000 tons displacement and 8in. guns for all the new cruisers they may lay down so long as the Treaty remains in force. The effect of this agreement may be two-fold. In the first place, no Power is likely to build ships of smaller size and lighter armament, which would be bad investments from every point of view; secondly, the cost of the standard cruiser will be heavy enough —£2,000,000 or more—to deter any nation, even the wealthiest, from embarking on a programme larger than its requirements urgently demand.

Visions.

THE science of propaganda which was developed during the war by all nations and was then pursued with an unscrupulousness which was defensible in the circumstances, has remained with us. It may lurk in the most innocent seeming paragraph or blazon itself in a great exhibition. Its difference from the ordinary advertisement is clear to all eyes. Without openly proclaiming the value of specified wares, it creates an atmosphere in which those wares are concealed. Wandering within that atmosphere, the public finds itself brought face to face with the merchant, who promptly benefits by the occasion. The origin of the World Power Conference leaves little doubt that propaganda for the electrical industry was the inspiring motive. It was begotten by the B.E.M.A., which is an association of electrical traders, and although the technical societies were induced to assist, and although there was more technicality than trade in it—indeed there was very little of the latter—there can be no doubt that its original object was less to encourage the dissemination of technical knowledge than to fill the air with the spirit of commercial electricity. In that object it was splendidly seconded by the Press—particularly the lay Press—which was quite carried away by the prospects it held out of a completely electrified world. We need not say that we sincerely trust its desires may be realised—in reason. We do not believe that electrification is the only solution of every problem, but we do recognise that the encouragement of the electrical industries will bring more trade to the country, and that the purely mechanical industries—machine tool building, as a notable example—will gain thereby. Individual exhibitors at Wembley give not very rosy accounts of business done, but most of them appreciate the fact that the result of the Empire Exhibition will be to augment the total volume of trade of the country, and that, in the long run, all individuals will benefit. The World Power Conference may be regarded in a similar light. In its character of propagandist, it has provoked a livelier interest in electrical developments which sooner or later will exhibit itself in the form of more orders for all branches of engineering.

Whilst it is pleasant to consider the material benefits that we hope to enjoy from the Exhibition and the Conference, it is refreshing to turn from the trade aspect to such visions as Mr. A. A. Campbell Swinton opens before us in the letter published in our correspondence columns this week. Referring to the illuminating James Forrest Lecture which Professor Elihu Thomson delivered on July 8th—see THE ENGINEER of July 11th—Mr. Swinton discusses briefly the possibility of deriving electrical energy direct from the rays of the sun. That is, he says, a subject "singularly appropriate for discussion at the present time . . . inasmuch as its solution would solve once and for all, at any rate for the next few hundreds of thousands of years, the question of the exhaustion of coal, oil and other fuel." He dismisses the possibility—which has unsuccessfully engaged the attention of inventors for centuries—of employing the heat of the sun to drive steam engines. "No form of heat engine," he says, "could give the desired result. What is wanted is some direct and efficient method of converting the received electro-magnetic radiation into what Professor Elihu Thomson calls 'electric current energy,' utilisable in ordinary electric motors, without allowing the radiation to turn itself into heat at all. Once we allow the radiation to produce heat, we have of necessity degradation and loss, and all the consequences of the second law of thermo-dynamics." It is well for the world that it should have such a vision as this revealed to it by an electrician and scientist of Mr. Campbell Swinton's standing. For nearly a century and a-half—the rotatory steam engine dates from the last quarter of the eighteenth century—we have been, especially in this country, where water power is scanty, under the dominion of the heat engine. Our engineers, our physicists, our mathematicians, our chemists, even our electricians have devoted themselves solely—water power excepted—to the development of energy by the destructive oxidation of fuels. Sporadic efforts have, it is true, been made to generate electricity direct from coal, and in a small way we employ galvanic batteries, but by far the greatest volume of power in the world is produced by burning fuel under boilers. Hence we are so absolutely dominated by the heat engine that we are unable to think outside it at all. Under the influence of Sadi Carnot and Joule, we have become more and more confirmed in the belief that the only means of generating power is by the degradation of heat, until we have reached a condition in which our minds are unable to explore other physical sources of energy. It is only in quite recent years, actually since the introduction of the thermionic valve, that we have begun to see, very vaguely and dimly, the possibility that the vast resources of the atom may be exploited for the use of man, and now Mr. Swinton suggests that we may do even better, and, some day, derive the power we need by trapping the electro-magnetic rays of the sun, which fall upon the surface of Great Britain at the rate of 1000 horse-power per acre during the hours of daylight.

Such visions, called up by a scientific imagination, are very salutary. They take us outside the grooves in which we ordinarily work, and oblige us to think in other factors and other units. That they are not immediately practicable, is no reason for dismissing them. We have the assurance of the highest physicists that they are not impossible, and that in the search for them we shall not be chasing chimeras. The tiny beginnings of realisation are already visible. By persistent and unswerving endeavour, by constant thought, by endless research, by scientific devotion to an ideal, the quest will be achieved.

One Hundred Years of British Railways.

No. IV.*

PART I.—THE STOCKTON AND DARLINGTON RAILWAY AND ITS PREDECESSORS.

THE SURREY IRON RAILWAY AND THE CROYDON, MERSTHAM AND GODSTONE IRON RAILWAY.

THE first railway, as a railway and independently of any canal, to obtain an Act of Parliament for the incorporation of the owning company, for its construction and its tolls, was the Surrey Iron Railway. The company was certainly the first railway company. The fullest account of this line was given in an article in THE ENGINEER of January 5th, 1900, and from it some of the following particulars have been gathered. It may be added that in the Machinery Division of the Science Museum, South Kensington, are to be found a plan of the line, some views of the works as they now exist, and an original toll sheet dated June 1st, 1804.

The line was part of an ambitious scheme—no less than a railway from Wandsworth to Portsmouth. The period was a time when the English Channel swarmed with French cruisers and privateers. These dangers, it was considered, would be avoided by the proposed railway. Not only was the line to carry the large quantity of military stores that had to be sent to Portsmouth, but the bleaching works, flour mills, and snuff factories in the Wandle Valley at Wandsworth would be able to send their goods to the Thames and thence up the river to Brentford, where connection would be made with the Midlands and the North by means of the Grand Junction Canal.

The stockholders were mostly local men, and William Jessop was the engineer. The Bill received the Royal Assent on May 21st, 1801—41 Geo. III., c. 33. The Act recited at its opening, "Whereas the making and maintaining a railway for the passage of waggons and other carriages from or from near a place called Ram Field in the parish of Wandsworth to or near a place called Pitlake Meadow in the town of Croydon and a collateral branch from the said railway from or from near Mitcham Common to or near to a place called Hack Bridge (now spelt Hackbridge) in the parish of Carshalton and the making a dock or basin for barges and other vessels with a lock cut and other works from the said railway at or near Ram Field aforesaid into Wandsworth Creek and thereby to communicate with the river Thames in the said parish of Wandsworth, all in the County of Surrey, will be a great advantage to several considerable manufacturers established in the neighbourhood and to the inhabitants of many towns and places and of a very populous country lying on or near to the line of the said intended railway by opening a cheap and easy communication for the conveyance of coals, corn and other goods, wares and merchandize to and from the Metropolis and other places." The Act proceeded to say that the line was to be called the "Surrey Iron Railway." The land required was to be 20 yards in breadth, "except in those places where it shall be judged necessary for waggons or other carriages to turn, lie or pass each other or where any warehouses, cranes or weighbeams may be erected." Sec. 65 provided "That all persons whomsoever shall have free liberty to use with horse cattle and carriages the roads ways and passages to be made by virtue of this Act for the purpose of conveying any goods wares merchandize or other things to and from the said railway and docks basin and every part thereof without paying anything for the use of such roads ways and passages and also to pass upon and use the said railway with waggons or other carriages and into and use the said dock or basin with vessels properly constructed respectively, as hereinbefore mentioned and to employ the said wharfs and quays for loading and unloading such goods and other things upon payment of such rates as shall be demanded by the said company, not exceeding the respective sums herein (section 59) mentioned. . . ."

The line was double tracked. The basin referred to in the Act, with lock gates leading to the Thames, is still in existence, being situated a few yards east of the river Wandle.* At the time the present writer visited the place he found the Wandsworth, Wimbledom and Epsom District Gas Company—the present owner of the property—busy replacing the outer gates of the dock. The original gates have disappeared gradually within the last few years and an arm of one is all that remains. The original inner gates are intact and so is a drawbridge a little further from the river. Inside the inner gates is the basin, built to hold thirty or so barges for the traffic to or from the railway. At the time THE ENGINEER article of 1900 was written a wooden crane was in existence, but it has now disappeared. The site of the railway station and dock is to-day known as the Railway Wharf, and whilst "Ram Field" cannot be identified, there is the Ram Brewery, and until considerable street alterations were effected and York-road was continued up to High-street, and Red Lion-street swept away, there was a Ram-square.

The route of the Surrey Iron Railway is shown in Fig. 2. It came out of the Railway Wharf and proceeded along Red Lion-street. Until the alterations just named were made a kerb of the stone sleepers was in existence from the wharf gates to the Ram Brewery. The line crossed High-street and proceeded along what is now known as Buckhold-road up to the river Wandle, which was crossed by a wooden bridge. The line curved to the left and again crossed the river by a second wooden bridge and entered Garratt-lane at the site of the blacksmith's shop near the Waggon and Horses Inn—both landmarks have now disappeared. The east side of Garratt-lane was followed, and when the London and Southampton Railway was built the latter crossed the Surrey Iron Railway, near where

* No. III. appeared July 18th, 1924.

Earlsfield Station is to-day, by an arch of 22ft. span and 15½ft. high. The line was continued through Summerstown, crossed the London–Epsom highway on the level at Colliers' Wood just above Merton and continued to Mitcham Village along the present Church-road. Thence it followed the course of Ravensbury Park and Baron Walk, and, after crossing the Sutton main road, followed a course to the south of the existing Mitcham Station along what is now a public thoroughfare known as Tramway-lane, part of which was used for the construction of the Croydon–Wimbledon Railway. The latter line struck the course of the old railway at Beddington-lane Station, and the direction taken by the latter cannot now be traced until Waddon Marsh-lane is reached near the level crossing of the Croydon–Wimbledon line over the main road to Waddon. Thence it went by what is now a rough lane near the Croydon Corporation Electricity Works, and ended near where the Gun Tavern stands to-day, a little short of Croydon Parish Church, a total distance of 8 miles.

Near where Mitcham Junction Station now stands the branch, 1¼ miles, for Hackbridge and Carshalton, was led away to the South. It followed what is to-day known as the Tramway Path. There is also a Tramway Terrace, behind which the line passed and was continued past the "Goat" inn at Beddington Corner, over the ground now covered with schools, and in front of some old weather-boarded houses, to Carshalton Park, which it entered at Culver's-avenue lodge gates and crossed to the bridge over the Wandle.

The gauge of the railway was, according to THE ENGINEER article, 5ft. from centre to centre of the sleepers, and 4ft. 8in. within the outer faces of the flanges. The rails were rectangular plates 3ft. 2in. long of cast iron, 4in. broad in the tread, and 1in. thick, except for 5in. or 6in. at each end, where they were ¼in. thicker. Below the outside edge was a rib or fish-belly about 2ft. long to give additional strength. Above the inner margin rose the flange which guided the wheels. It was about 1in. wide at the base and rather less at the top. The flange was curved, being only 1¼in. high at the ends and 3¾in. in the middle. At level crossings the flanges were 1in. high and straight throughout. The rails were laid on stone sleepers 15in. to 16in. square by 8in. or 9in. deep, with a plug hole sunk about half way down. Into this an octagonal oak trenail was driven nearly to the bottom and sawn off even with the top of the stone. A hole was bored in the trenail, and into it was driven a spike that fitted a notch in the rails. The wagons were authorised to be drawn by horses, donkeys or mules.

On the Surrey Iron Railway a test of the capacity of a horse as a means of locomotion was carried out. According to the "Annual Register" for 1805 there was, on July 24th of that year, a trial as a result of a wager. In this case a horse drew, with apparent ease, twelve wagons, weighing 38 tons 4 cwt. 2 qrs., a distance of 6 miles in 1 hour 41 minutes, and brought back sixteen wagons weighing 55 tons 6 cwt. 2 qrs.

The line was opened on July 26th, 1803, but never made any headway, the opening of the Croydon Canal from Rotherhithe in 1809 seriously affecting its working. Its want of success, in fact, imperilled, at one time, the adoption of a railway instead of a canal between Stockton and Darlington. Matters became worse when its companion line, the Croydon, Merstham and Godstone —see below—was closed in 1838. In 1844 the Surrey Iron Railway was nominally purchased by the London and South-Western Railway, which company sold it to the London and Brighton Company. The latter found no use for the line except where the route of the Wimbledon and Croydon intersected it, and in 1846 an Act was obtained to abandon it. The material was recovered and removed to the wharf at Wandsworth and there sold. Some of the stone sleepers were used in making banks for the dock and are still to be seen there.

The Croydon, Merstham and Godstone Railway was a separate undertaking. It was sanctioned on May 17th, 1803, by 43 Geo. III., c. 35, which gave powers for the construction of a railway from the southern end of the Surrey Iron Railway to Merstham, 8¾ miles, and Reigate, a further 3¾ miles, together with a branch, 3¼ miles, from Merstham, by Chevington to Godstone Green on the high road between Croydon and East Grinstead.

William Jessop and his brother Josias were the engineers. Their estimate was £52,347, but the company could not raise more than £45,500, and so the line only got as far as Merstham limestone quarries, whither it was opened July 24th, 1805. Neither Reigate nor Godstone was reached. Its course followed the Brighton main road and can still be seen in places, especially near Purley. At Smitham Bottom the line of route was cut through by the Chipstead Valley Railway. Here there is still a piece of the original embankment which carried the railway up to a bridge—since removed—over the Epsom–Coulsdon road. On the other side of this road was another bit of embankment. Nearing Merstham the line went into a cutting nearly a mile long, and, in places, 30ft. deep. On this section there were three overbridges which still stand.

The line of the London and Brighton Company was planned to pass over part of the Croydon, Merstham and Godstone Railway. The Act of July 15th, 1837, of the former company, therefore, authorised the purchase of the line, which was made by the end of 1838, and by an Act passed July 1st, 1839, the Croydon, Merstham and Godstone Railway Company was dissolved.

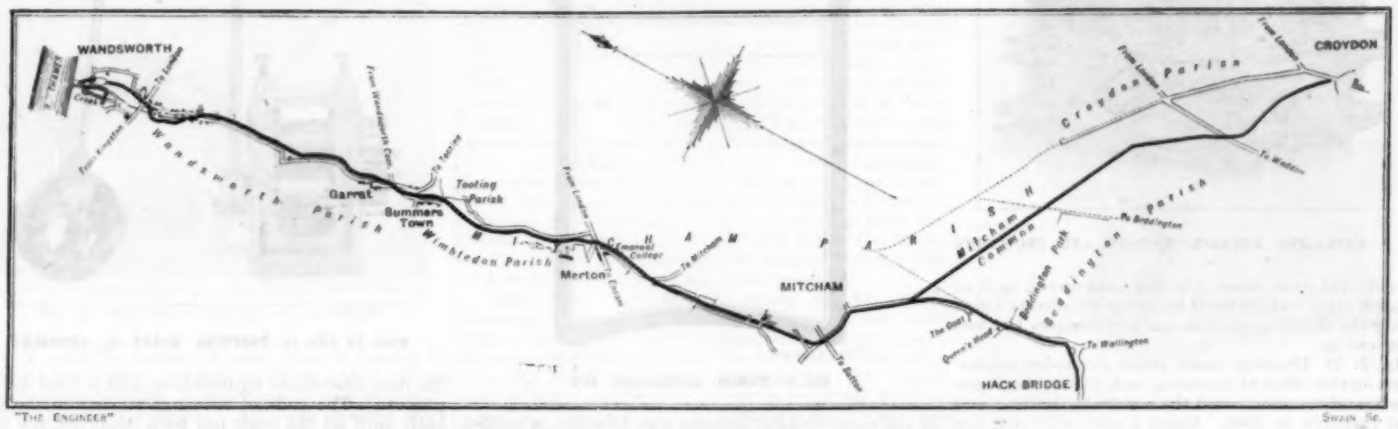


FIG. 2—MAP SHOWING THE ROUTE OF THE SURREY IRON RAILWAY

Obituary.

THOMAS LUMSDEN.

WE regret to have to announce the death, on the 17th inst., after a short illness, of Mr. Thomas Lumsden, at his home, Ravenswood, Low Fell.

Mr. Lumsden, who was only fifty-six years of age, was a Northumbrian by birth. Some thirty years ago he went to Gateshead and started business as an engineer, subsequently founding the Lumsden Machine Tool Company, Limited, of which, up till his death, he was managing director. He devoted special attention to grinding machinery, and was the inventor of numerous tools in that category. During the war he was director of the National Tool Factory at Gateshead. He was a member of the Institution of Mechanical Engineers.

BOOKS RECEIVED.

British Oil Engines. By W. A. Tookey. London: Percival Marshall and Co., 66, Farringdon-street, E.C. 4. Price 2s. 6d. net.

The Birth and Development of the American Submarine. By Frank T. Cable. London: Harper and Brothers, 45, Albemarle-street, W. 1.

Traité de Stabilité du Matériel des Chemins de Fer. By Georges Marié. Paris: Librairie Polytechnique Ch. Béranger, 15, Rue des Saints-Pères. Price 58f.

Coal and Oil-fired Boilers. By Engineer-Commander F. J. Drover, R.N. London: Chapman and Hall, 11, Henrietta-street, Covent Garden, W.C. 2. Price 16s. net.

Coal and Power. Result of inquiry presided over by David Lloyd George, O.M., M.P. London: Hodder and Stoughton, Limited, 8t. Paul's House, Warwick-square, E.C. 4. Price 1s. net.

A Dictionary of Electrical Terms. By S. R. Roget, M.A. (Cantab.) Assoc. M. Inst. C.E., A.M.I.E.E. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

The Planning, Erection and Operation of Modern Open-hearth Steel Works. By Hubert Hermanns. Translated from the German. London: Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 42s. net.

British Wire-drawing and Wire-working Machinery.

No. II.—WIRE DRAWING.

IN the first article of this series a short description was given of the process of making the rods which are subsequently drawn down to form wires, and it was pointed out they are generally from $^{3}/_{16}$in. to ¼in. in diameter, round in the case of steel, and square with rounded corners for most alloys. From these raw materials wires of a remarkable fineness are regularly drawn. Thus the smallest commercial size in low or medium-carbon steel is 0.0025in. in diameter, while hard-steel music wire is drawn down to 0.005in. diameter. Copper can be reduced to 0.001in., and nickel silver and pure iron to 0.002in. The very finest wire made is of platinum, 0.00003in. in diameter, but it is not produced by a simple drawing action. The platinum is encased in silver to bring it up to a workable size, and this silver is subsequently dissolved away. Another rather fine example of wire drawing was carried out at the Glasgow Exhibition, when a single piece of copper wire over 100 miles in length, but with a weight of only 11 lb., was produced. It took forty hours to run the wire through the machine. Two other fine examples of wire drawing in copper are exhibited at the British Empire Exhibition. One is a coil of ⅛in. wire, 7½ miles long, in a single piece, weighing 2120 lb., while the second is a spool of No. 47 gauge, which weighs only 16½ oz., but contains 20 miles of wire without a joint.

The process of reducing the size of a piece of metal, by forcibly pulling it through the contracting orifice of a die, to the extent indicated by the foregoing notes, must obviously change its physical properties very considerably, and it may be as well to give here some consideration to this aspect of the industry. The subject has been dealt with at considerable length by several authors, notably by J. D. Brunton, *Journal* of the West of Scotland Iron and Steel Institute, 1900; J. D. Brunton, *Journal* of the Iron and Steel Institute, 1906; P. Longmuir, *Journal* of the Iron and Steel Institute, 1912; and by Dr. F. Johnson in a lecture before the Birmingham Local Section of the Institute of Metals. The following notes are largely based on those writings.

There seems to be some difference of opinion among wire drawers as to the necessity for annealing rods before they are sent to the draw bench, and this difference may be accounted for by the relative importance attached to the variations in the characteristics of the rod at different parts of its length, to which reference has already been made. Mr. Longmuir found, for instance, that even when special efforts were taken to ensure uniform conditions in rolling a rod over 1000ft. long, the maximum tensile strength at the beginning of the coil was 47.6 tons per square inch, with an elogation of 14.7 per cent. in 2in., while at the end of the coil the corresponding figures were 50.6 and 13.6 respectively. If such a rod be subjected to the cold-working of drawing through a die, without first being annealed, he suggests that the process will fix the "habit" of the metal, which will persist through subsequent annealing stages, with the result that the final wire will lack uniformity.

In such cases the wire drawer is apt to blame the steel maker for the bad quality of the wire, whereas if he would anneal his rods before drawing, the trouble would probably be overcome.

Annealing is effected in much the same manner as in ordinary engineering practice. The coils are put into cast iron pots, the lids of which are luted on. The pots are then heated up to redness and allowed to cool again before being opened. On the Continent a special furnace for annealing is somewhat in vogue. In it the wire is gradually heated to a temperature of 850 deg. in a closed retort filled with inert gas. The temperature is then allowed to fall slowly to about 100 deg. before the wire is taken out. Wire thus

* No. I. appeared July 18th, 1924.

annealed is said to be ready immediately for further drawing.

Barron and Crowther, of Preston, make the special furnace and annealing pot shown in Figs. 7 and 8. The pot, it will be seen, has two lids 5 and 6, the lower one of which is formed as a tray for holding charcoal. The wire to be annealed is put into the light container 7, which is made of steel plate about No. 16 S.W.G. thick, together with a few pieces of charcoal. The lids are then put in place, the top one pegged down and the pot put in the furnace. When the wire is annealed the pot is taken out of the furnace as quickly as possible, and a flexible metallic tube 2 used to connect it up with the gas service. The connection is made by means of a weight 3 and cone joint 4. The gas fills the space between the lids, and is kept on until the charge cools down. As it issues from the outlet, it is lighted to give an indication that the space below is filled with gas. In this way oxidation of the wire is prevented, and it comes out quite bright, ready to go to the drawing block. This arrangement is

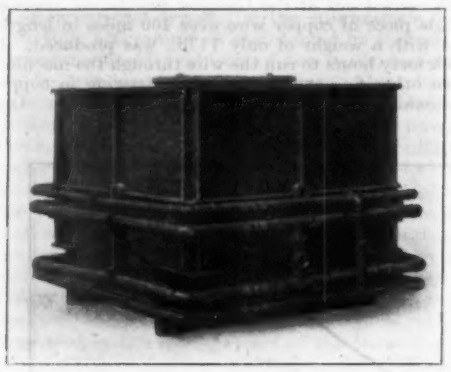


FIG. 7—ANNEALING FURNACE—BARRON AND CROWTHER

specially valuable when drawing hard metal, such as stainless steel—which must be annealed several times during the drawing process—as it eliminates the loss from scaling.

Mr. J. D. Brunton made some extensive experiments on the effect of annealing rods before they were drawn, and communicated the results to the Iron and Steel Institute in 1906. Using a steel wire rod, hot rolled, containing 0.75 per cent. carbon, he found a maximum stress of 52.5 tons per square inch, and an elongation of 15.3 per cent. in 8in. The rod would stand twenty torsions in 100 diameters. After being annealed for two hours in a close oven—without the flame touching the material—at a final temperature of 765 deg. Cent., and then allowed to cool slowly, the maximum stress was reduced to 47.3 tons, while the elongation was increased to 22.25 per cent., and the torsions to twenty-three. It is noteworthy, also, that annealing reduced the specific gravity from 7.753 to 7.748.

After cleaning to free them from scale, a process referred to later, and preparation for drawing, the two samples had the following characteristics :—

	Plain rod.	Annealed rod.
Maximum stress, tons per square inch	48.1	47.4
Elongation in 8in., per cent.	14	24
Torsion in 100 diameters	15	34
Specific gravity	7.754	7.748

The samples were then drawn at a speed of 142ft. per minute, and a reduction of 7 per cent., with the following results :—

Maximum stress, tons per square inch	62.6	56.9
Elongation, per cent.	7	6
Torsion	13	20
Specific gravity	7.770	7.760

A second annealing at a temperature of 890 deg. Cent. was then carried out, and new tests showed :—

Maximum stress, tons per square inch	62.1	61.4
Elongation, per cent.	15	17
Torsion	42	42
Specific gravity	7.750	7.749

After a final pickling, the two samples were drawn down through seventeen passes, during which the maximum stress steadily increased to 152 tons per square inch in the case of the untreated bar and to 165 tons for the annealed bar. The elongation and resistance to torsion varied erratically during the reduction of the wire, but there was a noticeable decrease in both towards the end of the drawing. One

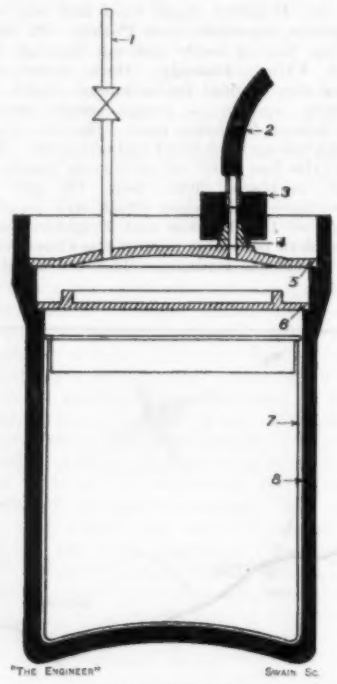


FIG. 8—BARCO ANNEALING POT

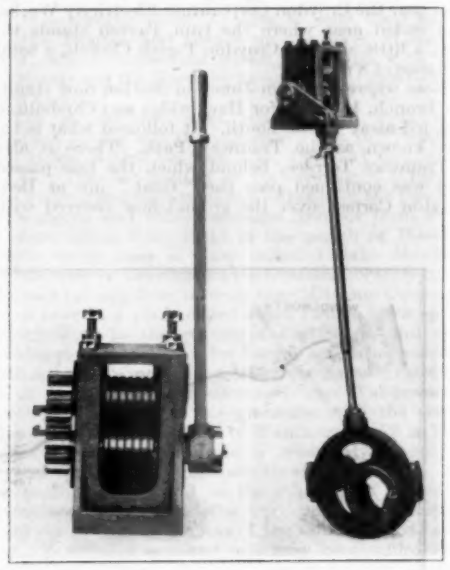
of the most striking features was, however, a sudden drop in the specific gravity after the last pass, following a steady increase up to that point. The maximum density attained was 7.998 sp.g., and the next pass produced a reduction to 7.997, which shows, according to Mr. Brunton, that it is impossible to increase the density beyond the larger figure by pulling the metal through a die. He also says that these experiments show that "annealing the rod before the final annealing does not, in any way, produce better material, as it has been thought to do, and is therefore not necessary."

On the other hand, the character of the final wire can be very materially affected by the heat treatment which the material receives in the course of drawing, and steel wire is habitually subjected to the processes of "patenting" and tempering at one period or another during its reduction from the original rod. "Patenting" is a term used in the wire-drawing trade to describe a process somewhat akin to annealing, which aims at leaving the material in the sorbitic state. Different manufacturers have different methods of patenting, but the process may be generally described as heating the wire to such a temperature that the carbon and the iron in the steel become homogeneous throughout, and perfect inter-diffusion of the carbon and iron is effected. When in this condition the wire is cooled down sufficiently rapidly and the condition is retained. Patenting temperatures generally range from about 550 deg. to 700 deg. Cent., but sometimes the temperature is carried as high as 950 deg. Cent. Tempering is merely a modification of the patenting process. The furnaces for these processes will be described later.

There are, of course, other peculiarities of wire rods which affect their suitability for drawing, such as segregation in the ingot and cold shuts in rolling, but they are outside the control of the wire drawer, and need not be discussed here.

The pickling or cleaning process already referred to is one of the most important stages in wire drawing, and is not only concerned with the removal of the mill scale from the rod, but also with the preparation of the wire rods for the drawing blocks.

The primary object of pickling is, of course, to remove the mill scale, so as to prevent it damaging



FIGS. 10 AND 11—POINTING ROLLS—G. CROSSLEY

the dies, and dilute hydrochloric acid is used for the purpose. The coils of wire rod are left in the acid bath until all the scale has been dissolved, are then washed in clean water, and "banged" on the floor to remove any adhering dirt. Machines have been evolved for doing the banging, notably one by Mr. Titley, of Birmingham, by jolting the coils of wire on excentrically operated pegs; but although the work of manual banging is certainly arduous labour, it appears to be preferred in most factories to mechanical means. It is not, however, always necessary to bang the rods, and some come out of the bath so clean that they can be passed on to the next operation directly.

The rods are then thoroughly washed and allowed to stand for some time until they are "browned," or coated with a thin film of ferric-hydrate. This coating of the rod is very important, and has a great influence on its subsequent behaviour in being drawn down to fine wire. During the browning process it is important that the metal should be kept moist with water, and have free access of air to get the desired coating. If the coils are allowed to dry they will get rusty, and cause trouble in the drawing. The extent to which the browning is allowed to progress is dependent on the fineness of the wire to be drawn—the finer the wire the thicker the coating.

The coils are then dipped into boiling lime water, to neutralise any free acid, and finally baked at a temperature of about 100 deg. Cent. The coating of lime serves the two purposes of (*a*) protecting the film of ferric-hydrate from damage, and (*b*) of preventing the surface from corroding. In some wire mills the rods

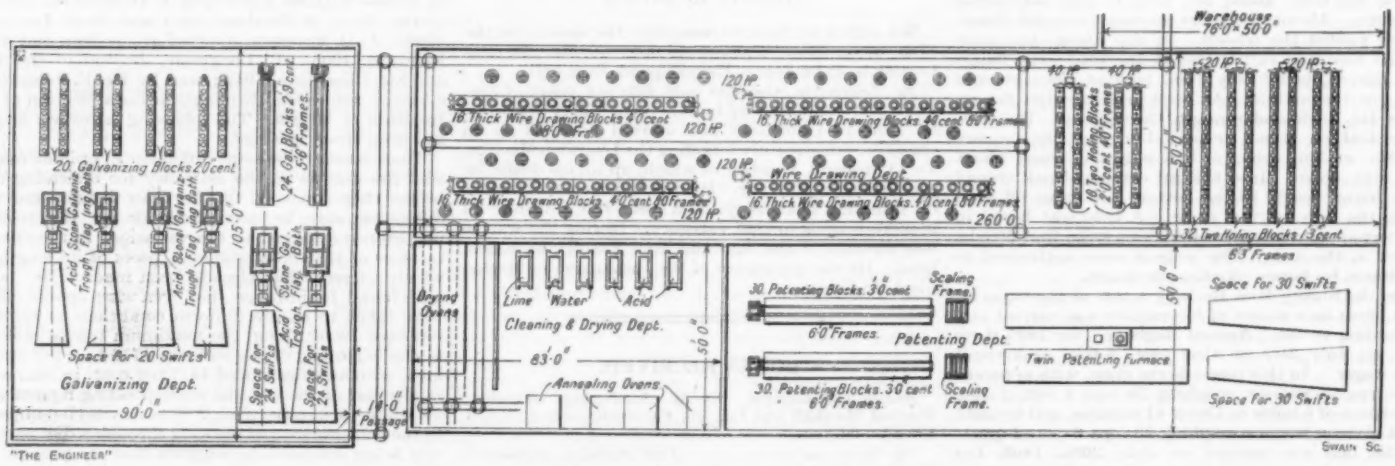


FIG. 9—GENERAL ARRANGEMENT OF TYPICAL WIRE-DRAWING PLANT

pass through an intermediate process, known as "lacquering," between the browning and liming. It consists of dipping the coils in a bath of dilute copper sulphate and flour, with several other ingredients, according to the fancy of the man in charge. The result is a faint deposit of copper, which helps to protect the browning.

The baking is very essential, as, were it omitted, the rod would probably be very brittle or possess "brittle of pickling," as it is termed in the trade. This characteristic was recognised as long ago as 1880, when Hughes found that unhardened steel pickled in hot dilute sulphuric acid became very brittle. He found that the steel absorbed some of the hydrogen liberated from the acid, and remained brittle until the hydrogen had been dissipated again. This dissipation can be effected either by long exposure to the air or by heating for a shorter period of time.

A piece of high-carbon steel wire, tough enough to bend on itself without fracturing, will, immediately after pickling, break off short on bending. If, however, it is left in the air for some time, or heated for a short time to from 250 deg. to 300 deg. Cent. immediately after pickling, it will bend double as readily as the unpickled material. Although Hughes attributed the embrittling effect to hydrogen, some investigators put it down to the acid itself, but, whichever may be the cause, the effect is very marked, and must be guarded against.

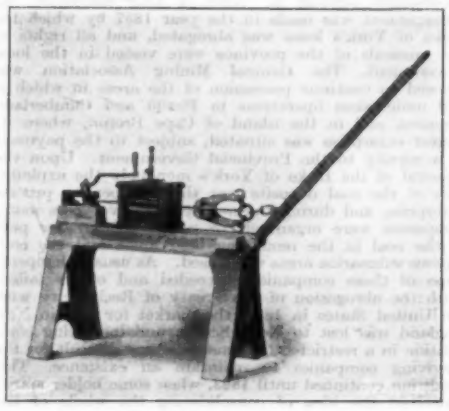


FIG. 12—POINTING FURNACE—G. CROSSLEY

The rod is now ready to go to the wire-drawing machine, but before describing the various types of drawing block, it may be as well to make a few comments on the general lay-out of a wire-drawing factory.

LAY-OUT OF FACTORIES.

That inertia of thought, or conservatism, among manufacturers which is so often the despair of economists, is perhaps more in evidence in the wire-drawing trade than in any other branch of engineering.

When wire drawing began to take a prominent place in the industries of Birmingham in the eighteenth century, the wire drawer did all the work pertaining to his business; that is to say, cleaned, drew and annealed the wire in turn, besides maintaining his dies in working condition. The result was that the shop was cluttered up with the plant necessary for all these operations, crowded close together, and there are still shops in Birmingham working on almost identical principles. In such circumstances the gear becomes grimed with dirt, and it is really remarkable that a presentable piece of wire can be produced.

There are, of course, some excellently equipped wire-drawing works in the Birmingham district, but it is noticeable that as one goes North the working conditions improve. In Birmingham the benches are almost invariably set against the walls of the shop, and as a consequence there is a tendency for refuse to collect beneath them, to the detriment of the gearing working the machines. In the North, however, the lines of drawing blocks are generally arranged out in the middle of the room, with the men working alternately on either side. This scheme has the advantage that both sides of the machines are accessible for cleaning or overhaul, while the staggered arrangement of the operatives reduces the overall length of the plant for a given output.

In modern works the pickling, annealing and pointing processes are carried out in departments quite distinct from the drawing shops, and there is a tendency for the maintenance of the dies also to be taken out of the wire drawer's hands. That is to say, in the most modern factories the dies are prepared in a special tool-room, and are issued to the wire drawer according to requirements. When they are worn, the dies are sent back for adjustment. The rods, also, are pointed ready for threading through the dies before they are sent to the drawing mill, and everything possible is done to sectionalise the work of the factory.

The power required for driving a wire mill is considerable—as much as 50 horse-power may be absorbed at a single die—and various formulæ have been put forward for its determination. One, suggested by an anonymous writer in the *Mechanical World* of 1916, Vol. 60, page 165, is as follows:—

$$\text{H.P.} = T\,(A - a)\,S\,\frac{F}{33{,}000}$$

T = Tensile strength of material in lb. per square inch before drawing.
S = Speed of drawing in feet per minute.
A = Cross sectional area of wire in square inches before drawing.
a = Cross sectional area of wire in square inches after drawing.
F = A factor selected from a curve in which percentage reductions of area are plotted as abscissæ and factors as ordinates.

There is, however, no unanimity on the subject, and it must be borne in mind that the friction of the material in the die is so important and so variable that it is very difficult to predict the power required, except on the basis of long experience.

The power is transmitted to the machines in the more old-fashioned mills by means of underground shafting, but there is a decided tendency to adopt electric driving. For the heavier classes of wire, it is best to provide a motor for each drawing block, while for lighter wires the blocks are generally grouped and driven by motors through shafts in the bases of the machines. The electric drive has the advantages that the speed may be varied as required by different gauges of wire, that the stoppage of one machine need not affect any others, while the machine can be started and stopped more conveniently when it is being prepared for work. The electric motor also has the merit that it gives a very smooth drive, which is almost as important in a wire-drawing factory as it is in a spinning mill. The drawing, Fig. 9, shows the general arrangement of a mill equipped with sixty-four main drawing blocks and their subsidiary appliances, and gives a good idea of a typical Yorkshire factory, as recommended by George Crossley, Limited, of Cleckheaton. It will be seen that the benches of blocks are arranged well out in the room, and that each bench has its own electric motor, while the several departments are well separated.

There are, nevertheless, many notable wire-drawing factories in the country which are still driven directly by steam engines, and for some classes of work that system is very hard to beat. The wire-drawing block runs at a comparatively low speed, and a large amount of power is required by the machines covering only a moderate floor space, so that with an engine and shafting the power can be delivered to the drawing block very economically and by means of plant not liable to get out of order. The question of reliability is naturally one of importance in any factory, but in a wire-drawing mill it is of paramount importance if there is to be peace among the men, as they are almost invariably paid on piece rates, and if the engine stops or anything goes wrong with the driving gear the men get very irritable.

At the Cleckheaton works of E. and A. Smith and Co.—one of the large steel wire firms of Yorkshire—the two mills are driven by two tandem compound condensing engines of some 800 horse-power each. These engines drive, directly, shafts running under the floor in the centre of each mill. The drawing machines are arranged at right angles to the main shaft, and are driven, through bevel gearing, by transverse shafts. With such an arrangement there are very few points where power can be lost in transmission, and with a fairly continuous programme of production it appears to be quite satisfactory.

ROD POINTING MACHINES.

There are several different methods of pointing wires in vogue, and the one adopted depends principally on the output of the machines it serves.

For small shops and odd jobs in the drawing shop, grooved rolls, such as those shown in Fig. 10, are very commonly installed. The grooves are made excentric to the roll, and by working the lever backwards and forwards, while the rod is pushed forward, and, if necessary, moved from groove to groove, quite a fine point can be made. Fig. 11 shows how a set of these rolls is adapted by George Crossley, Limited, to be driven off the main shaft, and fitted on a drawing bench.

A rather crude arrangement sometimes used is that shown in Fig. 12. It is merely a small gas-heated furnace, through which the end of the rod is threaded. When the material has been brought up to a bright red heat, it is pulled apart by the hand lever

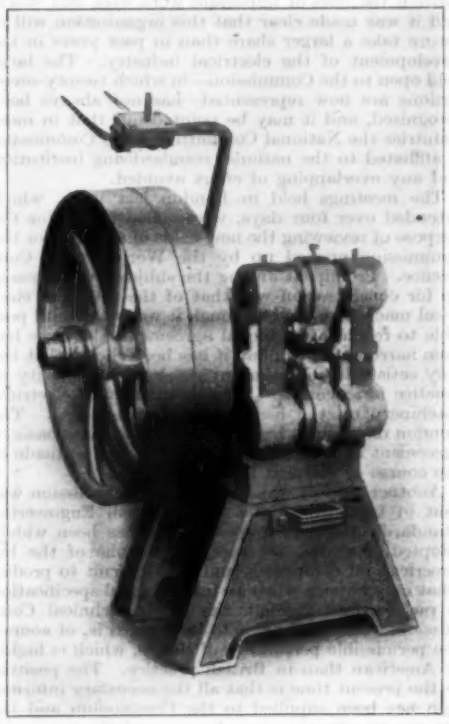
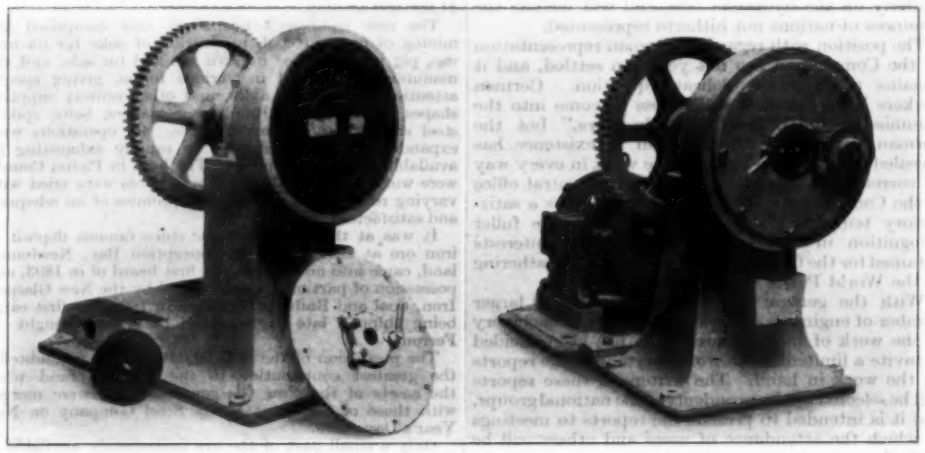


FIG. 13—POINTING MACHINE—G. CROSSLEY

shown, and the reduction of area at the fracture provides the required point. The system has the disadvantage that the end pulled off is scrap.

Another form of pointer is the toggle press shown in Fig. 13, which needs no description; but the most popular type in works having any considerable output is the swaging type of machine. One of these machines, by Sir James Farmer, Norton and Co., of Manchester, is illustrated by the engravings Figs. 14 and 15. It is very simple in construction, but very effective in operation. On reference to Fig. 14, it will be seen that inside a circular casing there is a set of rollers in a cage. The path on which these rollers run is of hard steel, and is held in the cast iron casing. Through the centre of the machine there runs a hollow spindle, driven by the gearing behind. The front end of this spindle is enlarged and slotted across its diameter. This slot provides accommodation for two rectangular dies, and, outside them, and two hammer blocks.



FIGS. 14 AND 15—ROTARY SWAGING MACHINE—SIR J. FARMER, NORTON AND CO.

The spindle is rotated at a speed of about 300 revolutions per minute, and as a consequence the hammer blocks are thrown out by centrifugal force. As they pass the rollers, however, they are forced in again and give the dies sharp blows. The rollers rotate, but at a speed different from that of the spindle,

and the dies consequently strike the rod inserted between them at different places all round, and it is quickly swaged down with a beautifully smooth surface and to a shape which corresponds to the form of the dies.

International Electrotechnical Commission.

AT last week's special meetings of the Advisory Committee of the International Electrotechnical Commission the lines of important work were laid down, and it was made clear that this organisation will in future take a larger share than in past years in the development of the electrical industry. The large field open to the Commission—in which twenty-seven nations are now represented—has not always been recognised, and it may be pointed out that in most countries the National Committee of the Commission is affiliated to the national standardising institution and any overlapping of effort avoided.

The meetings held in London last week, which extended over four days, were called partly for the purpose of reviewing the new fields of activity for the Commission opened up by the World Power Conference. Prominent among the subjects which came up for consideration was that of the rating of electrical machinery, and although it was not found possible to reach international agreement, the issue has been narrowed down, and it has been shown that the only satisfactory method of obtaining uniformity in practice is to compare the performance of electrical machinery on the basis of temperature rise. The London discussions have raised hopes that a basis of agreement is now in sight. A report will be made in the course of the next few months.

Another subject which came up for discussion was that of transformer oils. The British Engineering Standards Association specification has been widely adopted, but was not accepted by one of the big American oil companies, and it is difficult to predict what may happen when an international specification is put forward through the Electrotechnical Commission. The chief point to be decided is, of course, the permissible percentage of sludge, which is higher in American than in British practice. The position at the present time is that all the necessary information has been supplied to the Commission and the various specifications are being carefully examined. Attention is also being given to the evolution of an international system of graphical symbols, and it is probable that a report on this subject will be made in the near future. Nomenclature, traction motors—a new subject—and wayleaves in connection with high-tension installations were other subjects on the agenda at last week's meetings. Wayleaves for high-tension transmission systems have been a source of trouble, and it is hoped to put forward a model for rules and regulations which will simplify the work of those engaged in different countries in the erection of transmission lines. The model will be based on the excellent work which has been done by the Belgian National Committee. The International Committee on electrical prime movers, which did useful service in earlier years, has now been strengthened, particularly on the hydraulic side, and will include the nominees of nations not hitherto represented.

The position with regard to German representation on the Commission has not yet been settled, and it remains a somewhat delicate question. German workers have shown unwillingness to come into the Commission in the *rôle* of "observers," but the German Committee which is still in existence has revealed a disposition to assist the work in every way by correspondence passing through the central office of the Commission. This can be regarded as a satisfactory temporary arrangement pending the fuller recognition in this case, which German interests obtained for the first time in an international gathering at the World Power Conference.

With the general object of interesting a larger number of engineers and users of electrical machinery in the work of the Commission, it has been decided to invite a limited number of experts to make reports on the work in hand. The writers of these reports will be selected by the presidents of the national groups, and it is intended to present the reports to meetings at which the attendance of users and others will be invited.

The next general assembly of the Commission will be held at the Hague next spring, following the reception of a series of progress reports by the central office.

IN a report on the electrification of Sweden, drawn up by the Minister of Communications, it is stated that the total annual production of hydro-electric power in Sweden normally amounts to about 2800 million kilowatt-hours, while the Swedish waterfalls are estimated to be capable of producing a maximum of 35,000 million kilowatt-hours, so that only eight per cent. of the available power has hitherto been exploited. The continued exploitation of water power for industrial purposes cannot, however, be expected to reduce to any considerable extent Sweden's need of fuel, as the development of industry will simultaneously increase the need for fuel for heating, &c.

The Iron and Steel Industry in Canada.*

By CHARLES SYMONDS CAMERON, Secretary, British Empire Steel Corporation, Limited.

THE iron and steel works of Canada fall into two natural geographical divisions. One has its base on the Great Lakes and draws its supply of coal, and for the most part its supply of ore, from the United States. In this division lie the works of the Algoma Steel Company at Sault Ste. Marie, at the junction point of the lakes Huron, Superior, and Michigan, and the works of the Steel Company of Canada at Hamilton on lake Ontario.

The other division is in Eastern Canada, in the Province of Nova Scotia, and is entirely self dependent, having ample supplies of coal in that province and of ore in the neighbouring island of Newfoundland. Here we find the works of the Nova Scotia Steel and Coal Company and those of the Dominion Iron and Steel Company, both of which are merged in the British Empire Steel Corporation.

EASTERN CANADA.

The pioneers in the iron and steel industry, as it now exists in Eastern Canada, were a pair of metal workers, Fraser and Mackay, who in the year 1872 founded in the village of New Glasgow, in Nova Scotia, a modest forging plant, which they called the Hope Ironworks, whose capital did not exceed 4000 dollars—£800. These men had more than the hope which furnished the name for their company. They had courage and skill and faith in themselves and in the future. Their operations at first were largely devoted to the forging of ironwork for wooden ships, the building of which was then extensively carried on throughout the province and of railway axles.

The business expanded gradually and successfully, and in 1878 it was incorporated under the name Nova Scotia Forge Company, and the works were removed to Trenton just beyond the limits of the town of New Glasgow.

In order to supply the growing requirements of the forge works for its raw material the Nova Scotia Steel Company was formed in 1882, with a capital of 160,000 dollars, or a little less than £32,000 sterling. This company made steel in an open-hearth furnace by the Siemens process. It is worth mentioning here that when, from this furnace in 1879, the first steel ingots were cast, these were the first to be produced in Canada. These companies united on January 1st, 1889, under the name Nova Scotia Steel and Forge Company, which had been incorporated during the previous year with an authorised capital of 1,000,000 dollars, or about £200,000.

There existed in the neighbourhood of New Glasgow some deposits of iron ore which attracted the notice of the founders of the Nova Scotia Steel Company, which was now using a considerable tonnage of pig iron. In the year 1890 the New Glasgow Iron, Coal and Railway Company was organised, and at once undertook the construction of a blast-furnace at Ferrona in Pictou County, a railway to connect it with the ore deposits and with the coal mines in the neighbourhood of Stellarton and the steel works at New Glasgow, a coal-washer and a battery of coke ovens. The blast-furnace, which was first blown in in 1892, was quite successful, and until the supply of ore was exhausted, continued to produce Ferrona pig iron, which won for itself a most favourable reputation throughout the Maritime Provinces and as far west as Ontario.

On January 1st, 1895, the Nova Scotia Steel and Forge Company and the New Glasgow Iron, Coal and Railway Company were united under the name of the Nova Scotia Steel Company, which was incorporated in 1894 with an authorised capital of 5,000,000 dollars, or about £1,000,000 sterling.

The new company's operations now comprised the mining of ore and coal, production of coke for its own use, pig iron both for its own use and for sale, and the manufacture of steel in various forms, giving special attention to forgings, axles, and other railway supplies, shapes for agricultural implement makers, bolts, spikes, steel shafting and merchant bars. Its operations were expanding rapidly, and were as rapidly exhausting its available supply of iron ore. The beds in Pictou County were worked out. Other nearby sources were tried with varying results, but without any promise of an adequate and satisfactory supply.

It was at this time that the since famous deposit of iron ore at Bell Island, in Conception Bay, Newfoundland, came into notice. It was first heard of in 1893, and possession of part of it was obtained by the New Glasgow Iron, Coal and Railway Company in 1894, the first cargo being shipped late in the year 1895 and brought to Ferrona.

The possession of the Bell Island ore was undoubtedly the greatest contribution to the common fund when the assets of the New Glasgow Company were merged with those of the Nova Scotia Steel Company on New Year's Day, 1895.

Only a small part of the ore immediately available at Wabana, as the mine was named, could be used at the furnace at Ferrona, but an outlet for a large tonnage was soon found in the Eastern States of America and in Great Britain and Germany.

With the assurance of an adequate supply of iron ore of satisfactory quality, it was now possible for the company to look forward to larger extensions of its operations than had previously been within reasonable expectation. The Government of Canada in 1895 passed an Act to encourage the manufacture of iron and steel in the Dominion, providing for the payment of bounties upon all the pig iron and steel ingots produced in Canada during five years from 1895 to 1899 inclusive. In order to increase its operations in any large way it was necessary for the company to make such arrangements as would insure a lasting and sufficient supply of coal which as yet it did not possess.

Immense reserves of suitable coal were at hand in the island of Cape Breton, and so situated as to be conveniently accessible to excellent harbours to which the Bell Island ore could be transported with the least possible expense.

The existence of coal in Nova Scotia has been known for a long time. The French explorers had noticed outcroppings in the cliffs on the north shore of Sydney Harbour, and elsewhere along the eastern coast of Cape Breton, and early settlers had taken small quantities of coal from them.

The British Government was not entirely ignorant of the value of the coalfields in Nova Scotia, but for a long time after the country came into its possession took no steps to realise any material benefit from them, confining its operations to the supply of fuel for its garrisons, and refusing to grant leases or mining rights until King George the Fourth, just about one hundred years ago, used them for the purpose of relieving the pecuniary necessities of his brother, the Duke of York, to whom a lease was given of all the minerals in the Province of Nova Scotia. The Duke, who is reputed to have owed large sums to his jewellers, assigned the lease to them, and they, in 1825, organised a company called the General Mining Association, for the purpose of working the mines in Nova Scotia. The colonists, however, after a time began to resent this wholesale disposal of the mineral resources of the province, and protested strongly and successfully against it. After a long discussion an arrangement was made in the year 1857 by which the Duke of York's lease was abrogated, and all rights in the minerals of the province were vested in the local Government. The General Mining Association was allowed to continue possession of the areas in which it had undertaken operations in Pictou and Cumberland counties, and in the island of Cape Breton, where its largest enterprise was situated, subject to the payment of a royalty to the Provincial Government. Upon the removal of the Duke of York's monopoly the exploitation of the coal deposits was thrown open to private enterprise, and during the next twenty-five years many companies were organised, to which the greater part of the coal in the remaining land areas and the contiguous submarine areas was leased. As usually happens, some of these companies succeeded and others failed. With the abrogation of the Treaty of Reciprocity with the United States in 1867, the market for coal in New England was lost to Nova Scotia, and increasing competition in a restricted field made it very difficult for the surviving companies to maintain an existence. This condition continued until 1893, when some bolder spirits conceived the idea of consolidating the whole of the companies in the Cape Breton field, enlarging the scope of their operations, and replacing the lost New England market by increasing their disposals in the St. Lawrence region in which at the head of ocean navigation the city of Montreal had become an important industrial and shipping centre.

The Dominion Coal Company, Limited, was incorporated by a special Act of the Legislature of the Province of Nova Scotia in the year 1893, and having acquired the rights and property of nearly all the companies then in existence in the district south of Sydney Harbour, was granted a ninety-nine years' lease of the coal in a large territory, partly on land and partly in the submarine area adjoining.

The new company practically controlled all the coal on the eastern coast of Cape Breton, excepting what was still retained by the General Mining Association, which by this time had parted with all its property in Pictou and Cumberland counties and south of Sydney Harbour in Cape Breton, and now confined its operations to its holdings north of that harbour.

Such were the conditions in 1896 when the Nova Scotia Steel Company was considering an enlargement of its undertakings and was looking for that absolute prerequisite, an adequate and assured fuel supply.

Overtures were made to the Dominion Coal Company, which for a time promised to solve the difficulty, but nothing was accomplished. In 1899 a large part of the company's ore property at Bell Island was sold to the newly organised Dominion Iron and Steel Company, which was closely associated with the Dominion Coal Company. This left the Nova Scotia Steel Company two alternatives. The first was to enlarge its smelting works in Pictou County, transport from Wabana the ore required for their use to Pictou Harbour, and enlarge the existing arrangements for a supply of coal from the Pictou collieries. The second was to procure its fuel from the mines of the General Mining Association on the north side of Sydney Harbour, and establish new iron and steel furnaces near the coal mines and within easy reach of the ore mines.

The latter alternative was adopted, and in 1900 the company acquired the property of the General Mining Association at Sydney mines, consisting of Crown leases of extensive coal areas and four collieries connected with them, a railway to the port of North Sydney and shipping pier there.

In 1901 the Nova Scotia Steel and Coal Company, Limited, was incorporated with a capital of 6,030,000 dollars—£1,206,000—of which 5,000,000 dollars was in ordinary shares, and 1,030,000 dollars was in 8 per cent. preference shares. The new company took over the assets of the Nova Scotia Steel Company and proceeded to erect at Sydney mines a blast-furnace, open-hearth steel furnaces, coke ovens, and accessory works, and to develop and increase the colliery output and the facilities for shipping coal and receiving ore at North Sydney. At the same time the works at New Glasgow were enlarged and improved, and a new shipping pier was built at the ore mines, which were now being rapidly developed.

Meantime the Dominion Iron and Steel Company, previously mentioned, had established its works at Sydney. For some years the two companies pursued their operations vigorously and independently without serious interference or difficulty.

The Dominion Company at first confined its business to the production of pig iron and the heavier varieties of steel in the form of blooms, billets and slabs, later adding rails weighing from 60 lb. to 100 lb. to the yard, and mining little more than its own requirements of ore. The Nova Scotia Company produced pig iron of a slightly different grade and forms of steel that were more or less complementary to those made by its larger neighbour, and mined large quantities of ore for sale in Europe and

* Paper presented to the Empire Mining and Metallurgical Congress.

AN OVERHEAD ROPEWAY WITH SIDINGS

THE BRITISH ROPEWAY ENGINEERING COMPANY, LIMITED, LONDON, ENGINEERS

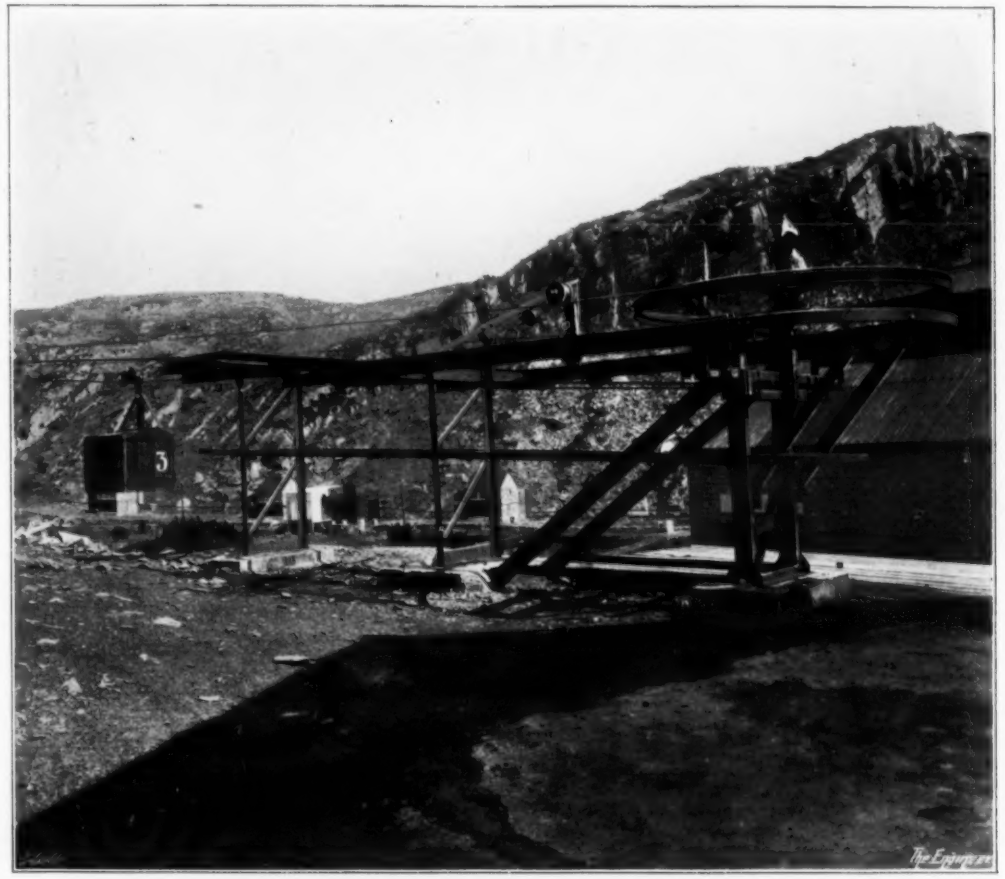


FIG. I.—LOWER TERMINAL STATION "A"

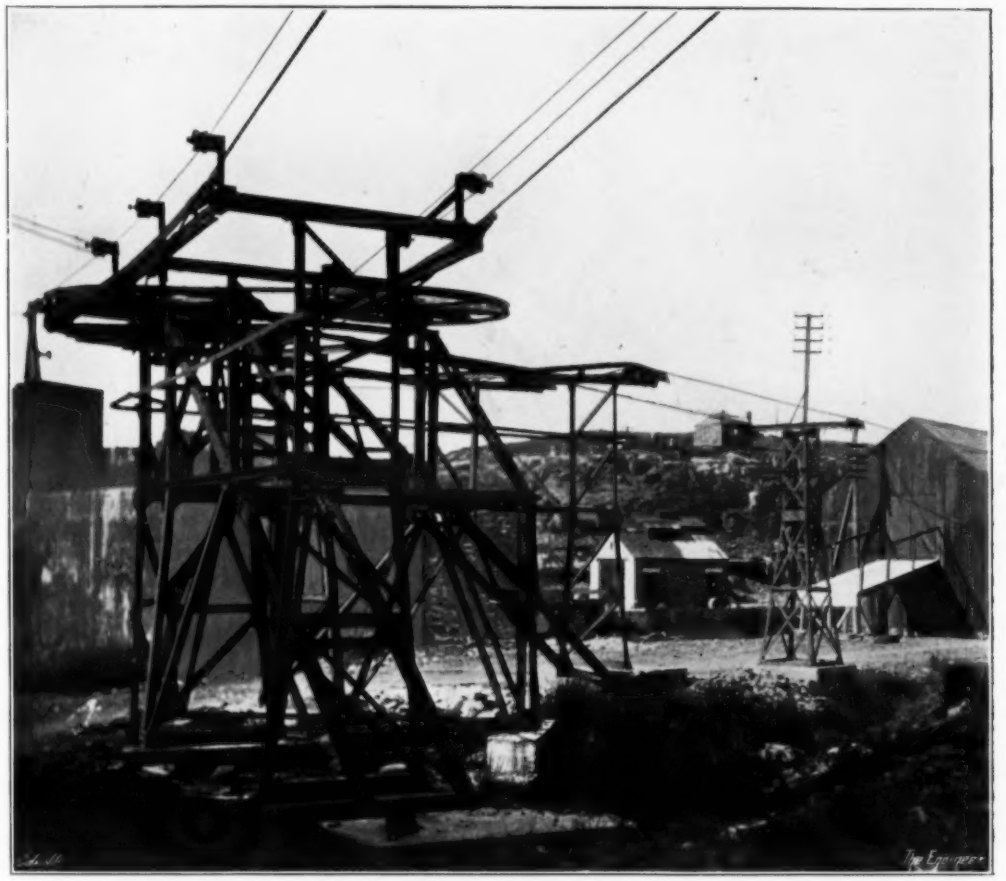


FIG. II.—TRESTLE AT ANGLE STATION "D"

FIG. III.—ANGLE STATION "E"

FIG. IV.—SHUNT STATION NO. 1

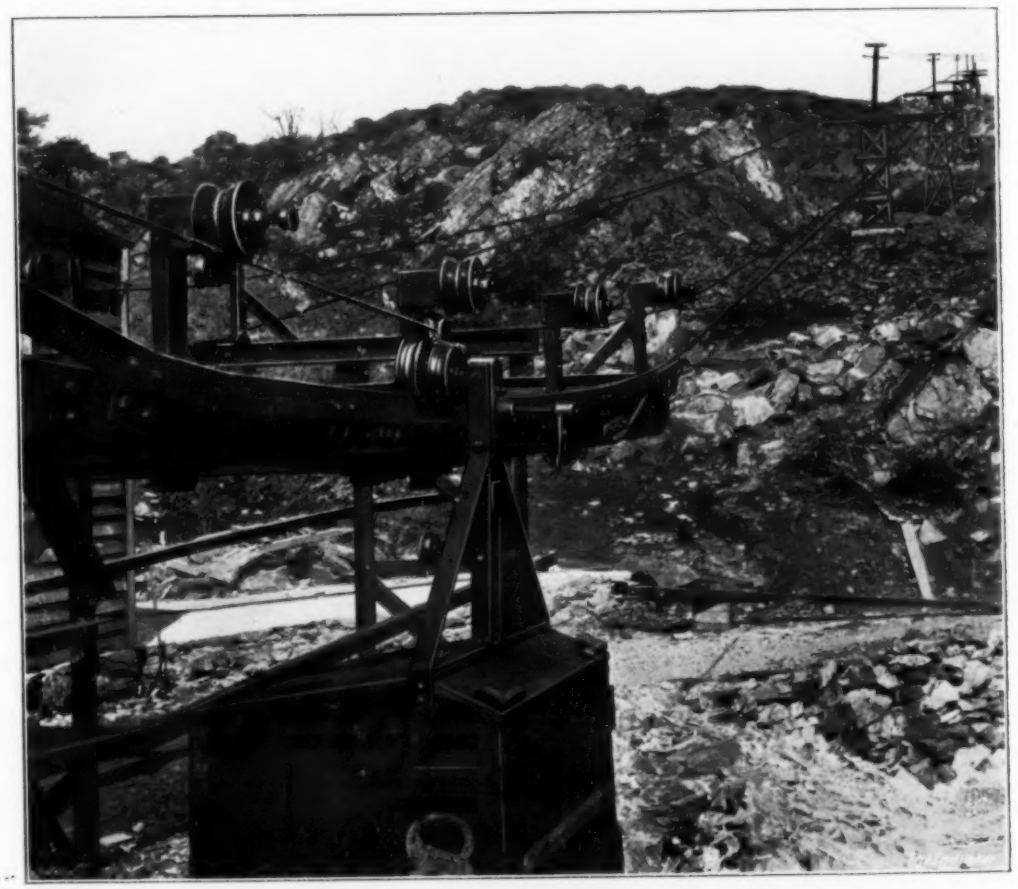


FIG. V.—LOWER END OF MAGAZINE LINE

FIG. VI.—TYPICAL SHORT TRESTLE ON LINE "A" TO "B"

the United States. Its output of coal beyond its own requirements was not large in comparison with that of the Dominion Coal Company. Later on, however, conditions changed. The Nova Scotia Company, having mined most of the ore in the portion of the Bell Island property which it retained, had to extend its workings to later acquired areas lying beyond those which it sold to the Dominion Company, access to which was obtained by going through the property of that company. The Nova Scotia Company and the Dominion Coal Company were extracting coal from areas lying side by side or one beyond the other to their common disadvantage, and sometimes with complaints that one was encroaching upon the property of the other, or that one could not profitably win its coal without passing through the property of the other. The interests of the Dominion Coal Company and Dominion Iron and Steel Company had become merged by the formation in 1909 of the Dominion Steel Corporation, which acquired the whole of the common shares of these companies, so that all interests relating to ore and coal and steel were united, on the one hand, in the Nova Scotia Steel and Coal Company, and on the other hand in the Dominion Steel Corporation. Their properties were interlaced and their field of action was becoming identical. To put an end to competition and interference of one kind and another, and to permit the most economical and profitable development of their properties, the natural course was to join forces. This was effected in the year 1921, when the British Empire Steel Corporation was formed, and acquired the whole of the common shares of the Nova Scotia Steel and Coal Company and of the Dominion Steel Corporation. The merger was accomplished without any addition to the previously existing capital stock, except enough to cover the equity of the holders of these stocks in the accumulated surpluses of the merged companies. The Capital Stock issued and in the hands of the public amounts to 91,164,475 dollars. In addition to the share capital there are bonds and debenture stocks outstanding to the value of 37,800,000 dollars. Of these probably one half were issued in sterling denominations and largely taken up in Great Britain.

Another noteworthy attempt to establish an ironworks in Nova Scotia should be mentioned.

About 1849 a company was formed to utilise a deposit of iron ore which had been discovered in the Cobequid Mountain, in the central part of the province, and which for some time gave promise of importance. Furnaces and other works were established at Londonderry a few miles from the main line of the Intercolonial Railway. Although the enterprise was more than once interrupted by difficulties of one kind or another, it was intermittently successful in producing merchant iron of good quality. Londonderry pig iron and bars were well and favourably known throughout a wide area in Canada for many years. The early promise of the Cobequid deposit, however, was not fulfilled, and the mines failed to furnish a sufficient supply of suitable ore. Other sources, notably those of Torbrook and Nictaux, on the south side of the Bay of Fundy, were tried, but without sufficient success to justify continuance of operations, which ceased in 1908. Since then the company has been liquidated and the works closed and dismantled. It has been estimated that about 2,000,000 tons of ore was treated during the time they were in operation. It is said that Sir William Siemens made his first experiments in the conversion of iron into steel at these works in 1874 and 1875.

Such in brief is the history of the iron and steel industry in Eastern Canada from its inception to the present time.

(To be continued.)

A Large Diesel-Electric Dredger.

A LARGE 30in. Diesel-electric suction dredger is to be built by the Port of Portland Commission, of Oregon, U.S.A., for use on the Williamette River. The new dredger has been designed by Mr. James H. Polhemus, who for several years was general manager and chief engineer of the Commission. In an account written by Mr. Polhemus for our contemporary, the *American Motorship*, the leading features of the design are given. The Commission already possess three 30in. steam-driven suction dredgers, but the Diesel-electric design was decided upon after careful consideration of the conditions under which the proposed new dredger will have to work. Most of the time it will be far away from electric transmission lines, and if it had been steam driven considerable expense would have been incurred by transporting the necessary fuel for burning in the boilers. The power required to operate the dredger will be furnished by four Diesel engines coupled to direct-current dynamos. The engines are to be built by the McIntosh, Seymour and Co., of Auburn, New York, and the electric generators and switchboard equipment by Westinghouse. The engines and dynamos are placed longitudinally in the ship in two pairs, the larger units consisting of six-cylinder 900 brake horse-power units and the smaller units of eight-cylinder 800 brake horse-power units. The total engine power is thus 3400 brake horse-power and the generators will have a total designed output of 2350 kilowatts. The main dredging pump is to be exceptionally heavy in design and will be made of cast steel. It is arranged to be coupled direct to a 2700 brake horse-power variable-speed motor giving a constant torque with a speed regulation of from 250 to 360 revolutions per minute. By means of this provision for speed reduction the varying duties for pipe lines of from 1000ft. to 7000ft. in length may be met by one size of pump impeller. The ladder or hinged arm to which the revolving cutter is attached is to be furnished with heavy trunnions at its inner end. A 250 brake horse-power motor operating through reduction gearing will serve to drive the cutter shaft, while the cutter itself is to be of the spiral type with a cast steel body and specially designed knives for dealing with very hard materials. There will be three sets of electric winches for swinging the dredger, raising the cutter arm and lifting the spirals respectively. The two latter winches will be operated by a 45 brake horse-power direct-current series wound motor fitted with reduction gears, while the motor for swinging the dredger is to be of the variable-speed type with an output of 75 brake horse-power. It will be operated on the Ward Leonard system. All three motors above mentioned are entirely independent. All clutch and brake controls will be electrically operated from the pilot house.

The dredger is to be furnished with steel spirals 35in. in diameter and 80ft. in length, carried in wells at the back of the dredger and supported by heavy steel brackets with cast steel keepers. The hull of the ship is to be specially constructed to accommodate the oil engines and generating plant, and a number of watertight compartments are to be provided. There will be four longitudinal and four transverse bulkheads with the fuel bunkers formed outside the longitudinal bulkheads. Sufficient oil—say, 3000 barrels—for a thirty days' supply can be carried.

The total weight of the completed dredger with 1000 barrels of oil in the bunkers is expected to be about 2300 tons. When working on average good material it is calculated that an output of about 50,000 cubic yards of material will be obtained. On the top decks comfortable quarters are to be provided for the officers and crew, and an electric kitchen and refrigerating plant with a laundry and a social hall constitute new features in dredger design. On the main deck there is to be provision for power-driven workshops for engineers, carpenters, and blacksmiths.

The contract for the hull of the vessel has been awarded to the Wallace Equipment Company, of Seattle. When this dredger is completed and set to work some interesting comparative figures on dredger working with steam and electricity may be expected.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

POWER FROM THE SUN.

SIR,—I am glad to see from the report of his James Forrest Lecture, contained in your issue for the 11th inst., that Professor Elihu Thomson has included among the "unsolved problems"—solution of which may it is hoped be reached in the course of future electrical progress—"the direct production of electric current energy from the rays of the sun by some form of absorbing ionic vacuum apparatus."

This is a subject to which I have drawn attention on numerous occasions during the last few years, perhaps most fully in a letter which I published in *Nature* for December 18th, 1919. It is also a problem singularly appropriate for discussion at the present time, when we have been holding a World Power Conference, inasmuch as its solution would solve once and for all, at any rate for the next few hundreds of thousands of years, the question of the exhaustion of coal, oil and other fuel, for the amount of solar energy continuously received on the earth during the hours of daylight, if only it could be efficiently harnessed, is ample for all human needs.

The amount of energy radiated continuously into space by the sun is prodigious, being some 9000 horse-power per square foot of the sun's surface, and as the diameter of the sun is 865,000 miles, there are a great many square feet. Our earth, of course, only intercepts a minute portion of what the sun sends out, but even so, this is by no means an insignificant amount, as even in the climate and position of England, and after allowing for absorption by the atmosphere and the clouds, the average solar energy received per acre of the earth's surface in our own country during the hours of daylight exceeds 1000 horse-power. If, then, some method could only be devised for efficiently converting this solar energy into a form in which it could be readily applied for motive power and other purposes, the gain would be enormous, for in many cases sufficient energy to run all the machinery in a factory could be collected from an area not greater than the factory's roof.

Let it be understood, however, that no form of heat engine could give the desired results. What is wanted is some direct and efficient method of converting the received electro-magnetic radiation into what Professor Elihu Thomson calls "electric current energy," utilisable in ordinary electric motors, without allowing the radiation to turn itself into heat at all. Once we allow the radiation to produce heat, we have, of necessity, degradation and loss and all the consequences of the second law of thermo-dynamics.

All this, however, should be possible of avoidance, for to-day, with our crystal and ionic detectors in modern wireless telegraphy, we habitually convert electro-magnetic radiation into continuous electric current with fair efficiency, and without bringing in heat engine action at all. The only difference is that, whereas in wireless telegraphy we are dealing with electro-magnetic waves with a wave length of hundreds or thousands of metres, in the case of radiation from the sun the wave length is only a minute fraction of a millimetre. This, however, is only a question of degree, and there does not appear to be any thermo-dynamical or other objection to the possibility of a method being discovered of dealing with the shorter waves on some similar principle to what is already found possible in the case of the longer ones. Let it be understood, that there is here no question of a Maxwellian "demon," such as is necessary to render available for motive power purposes the general stock of heat energy at uniform temperature, nor does the solution of the problem seem as remote as the obtaining of power from the liberation of the internal energy of the atom.

At present we do not know of any solution of the problem, but that is not to say that it is a problem incapable of solution. I wish that Professor Elihu Thomson had pursued the subject further than he did, for I am sure he would have been illuminating; but anyway, it is something to know that he regards the problem as one for which he hopes that an electrical solution may be found.

In conclusion, let me point out that it is a problem of surpassing interest, and one of supreme importance to the race.

A. A. CAMPBELL SWINTON.

London, S.W. 1, July, 21st.

MAXIMUM POTENTIAL GRADIENTS.

SIR,—In Mr. Llewllyn B. Atkinson's very valuable paper on the subject of cables, contributed at the World Power Conference, remarks were made—though I am sure they were not made with that object—which might lead one to imagine that every effort to meet the conditions in extra high-tension cables by seeking to distribute the maximum potential gradients through the cable, was based upon insecure, or at least questionable, premises.

I quite believe that what Mr Atkinson had primarily in mind were the attempts which have been made—whether by introducing different impregnating substances into the paper at different distances from the copper core, or whether by using materials having different dielectric constants—to make the potential gradients more uniform through the cable. Moreover, the allusions which he made during the discussion to the fact that cables having copper cores of small diameter had stood up without breakdown to dielectric stresses which, calculated according to the recognised formulæ, must have been very considerable, need not, I submit, cause any misgiving.

In whatever degree practice seems to depart from theory as regards these effects on very small copper cores, the departure is all in the direction of what I may call the "safe" side. Hence, it follows that if, as I have done, cables are calculated out on the basis of making the maximum potential gradient a quite reasonable amount and one that is known to be safe with larger cables, no worse result will obtain than what has already been found, viz., that the cable will do its work excellently.

The point which, however, I desire to emphasise is that when we come to single-core cables intended for, say, 130,000 volts, in which the makers have reached absolutely the limit of depth to which they can satisfactorily impregnate the insulation; whether those cables have been designed on the maximum gradient theory or the average gradient theory is of no moment as regards further progress. The fact remains that in any case the makers have reached the limits to which they can impregnate.

If, now, it be granted that it is possible to take away the cable at this stage, before the lead sheath is put on, and to introduce two "intersheaths" in the way that I propose to do for the "Hexaphase" system, and if these intersheaths are of such a large diameter that there is a comparatively small difference between their minimum and their maximum stresses, then a great gain has immediately been made, quite above any challenge whatever.

The whole point at issue is whether the central insulation of the cable can be made to withstand two separate impregnations. The cable to which I alluded the other day proves conclusively that this can be done; it also proves that these intersheaths may each be of the order of thickness of 0.3in., and that they can withstand some 35,000 volts apiece; which, multiplied by $\sqrt{3}$, gives 121,000 volts of transmission. This has been added to the original 130,000 volts, after the single-core advocates have confessedly reached the end of their tether, by the simple expedient of the two intersheaths, and we obtain immediately a cable, subject to the joint question being satisfactorily solved, suitable for a voltage of 250,000 volts, without exceeding a maximum potential gradient anywhere of more than 50 K V/cm., and this, too, with a 0.15 square inch copper core.

As already pointed out, a cable has been made, designed only for 150,000 volts, which has come through "smiling" after a test equivalent to 338,000 volts maintained for three-quarters of an hour; and working on identical lines and similar calculations—which, as I have already shown, err on the safe side—we ought to be able to design a cable for 220,000 volts with an overall diameter under the lead of 4¼in., or, say, 5¼in. over the lead.

In any case a cable has been made which appears to be thoroughly serviceable for 150,000 volts, and is only 2¼in. diameter under the lead. This, I believe, it is quite beyond the possibility of single-core cables to accomplish for equal limiting stress and for an equally small core cross section.

A. M. TAYLOR, Major S.O.2.

Erdington, July 19th.

LINKS IN THE HISTORY OF THE LOCOMOTIVE.

SIR,—May I supplement Mr. Dendy Marshall's most interesting contribution in your issue of July 4th, with information recently brought to light by Mr. Marshall himself in some original letters from Robert Stephenson to his father George. These letters are now in possession of Messrs. Robert Stephenson and Co., to whom I am indebted for copies.

Your article on Locomotive No. 28 of the Liverpool and Manchester Railway in 1832 refers to the competition of Edward Bury with the Stephensons as a designer of locomotives, and Edward Bury's name is well known in this respect. But when writing "A Century of Locomotive Building," I arrived at the same conclusion as some other writers—that the design of Bury's locomotives was largely due to James Kennedy, who eventually became a partner in his firm, and that Kennedy himself owed much to his previous experience with Robert Stephenson and Co.

This view has received striking confirmation from a passage in one of the letters from Robert Stephenson referred to above. Writing to his father on December 18th, 1832, with reference to a proposed appointment at his Newcastle works, he explains his unwillingness to introduce a stranger into the factory, because, he says—"It is only teaching another how to manage the details of locomotive engines. If Kennedy had not obtained a great deal of information from us here we should have stood much higher as locomotive engine makers than we do now. *Bury would never have made an engine.*"

The italics are mine. J. G. H. WARREN.

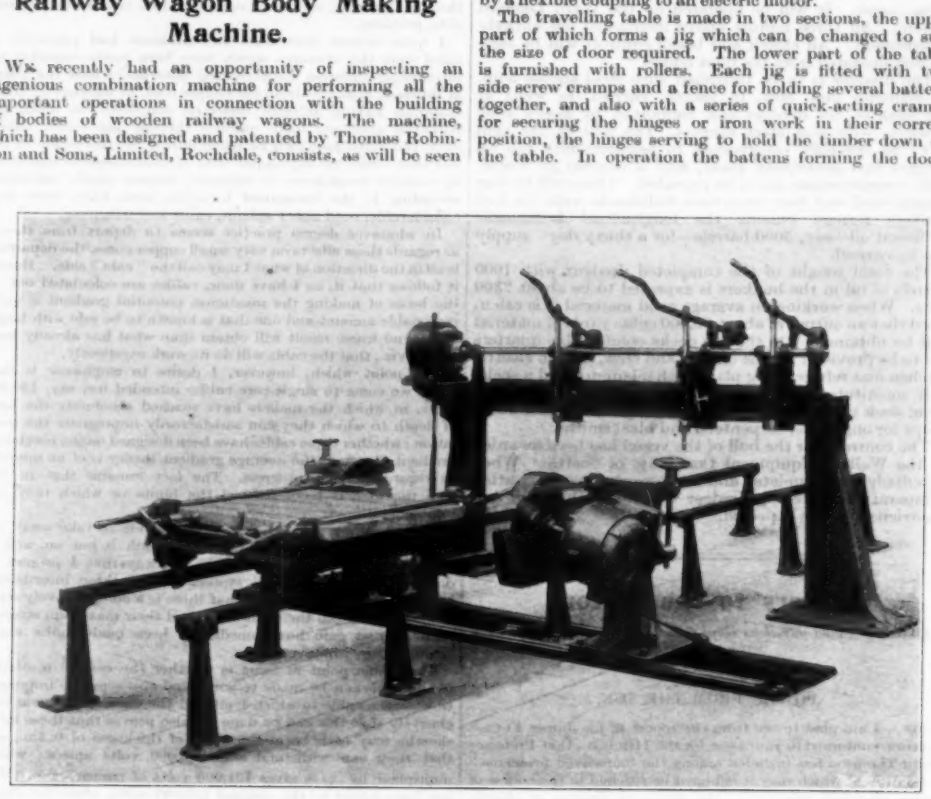
July 22nd.

SPEAKING at the General Federation of Trades Unions at Bournemouth on the 11th instant, Colonel John Ward, the member for Stoke-on-Trent, said that the Government had under consideration at the moment schemes for improving internal waterways involving the expenditure of millions of money. Two weeks ago two Cabinet Committees sat on a scheme for the improvement of the canal between the Potteries and the Mersey. The scheme involved the taking over of the canal by the Government from the present owners, the London, Midland and Scottish Railway Company. The company for its own reasons would not even negotiate the sale, but the Government proposed to take the bull by the horns and compel sale at a reasonable figure. The scheme when completed would provide the Potteries with a valuable means of communication with the Mersey. To this we would add that it is not surprising to hear that the railway company objects. The Trent and Mersey Canal is an important integral part of the North Staffordshire section and is the only railway-owned canal that makes a profit.

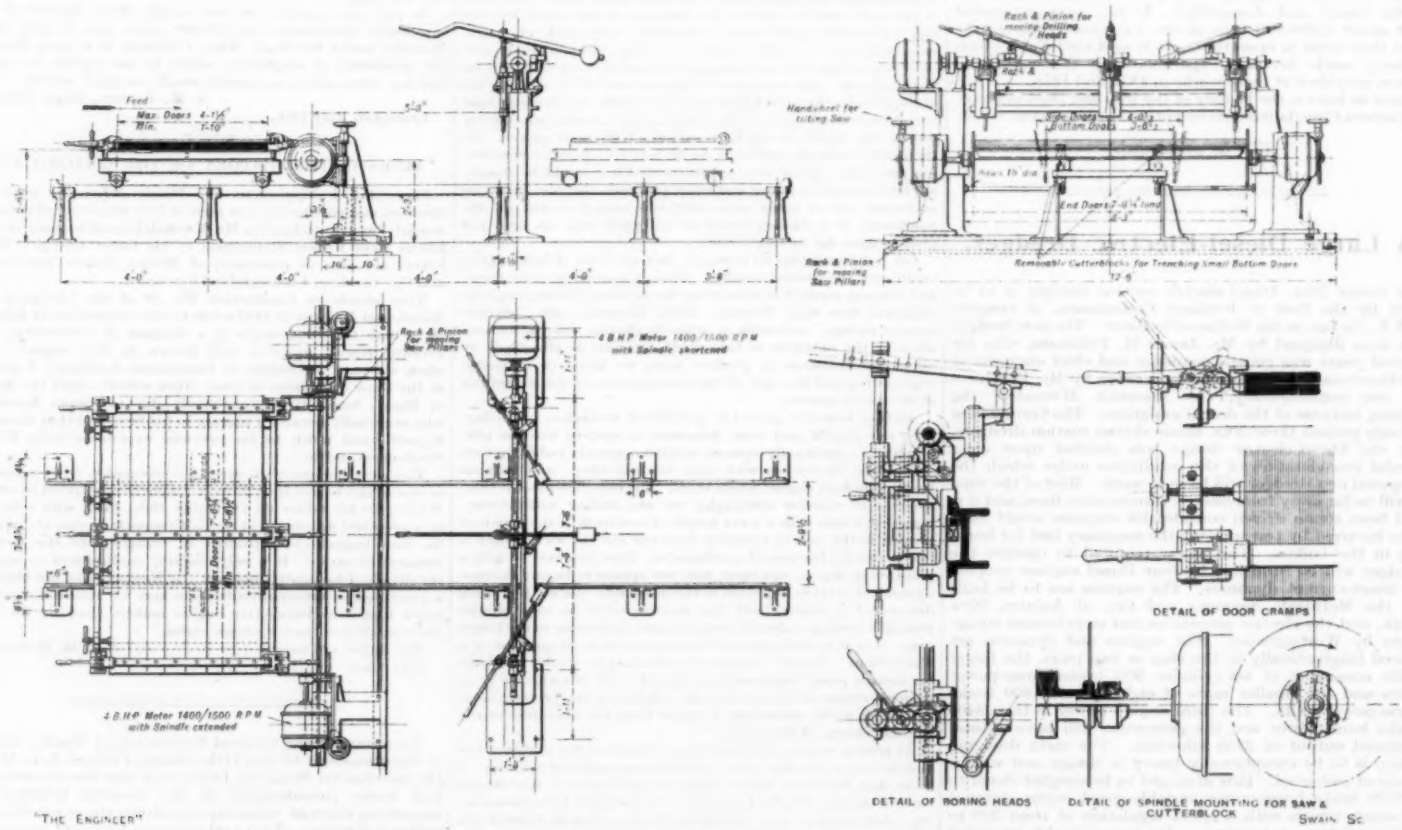
Railway Wagon Body Making Machine.

We recently had an opportunity of inspecting an ingenious combination machine for performing all the important operations in connection with the building of bodies of wooden railway wagons. The machine, which has been designed and patented by Thomas Robinson and Sons, Limited, Rochdale, consists, as will be seen from the accompanying engravings, of a travelling table for carrying the jigs, the table being mounted on a rail gantry, on each side of which a motor-driven cross-cut saw is provided. The saws can be adjusted apart to deal with the length of work in hand, and can be canted for cutting on the bevel. Their spindles are also extended to carry cutter blocks for trenching. Behind the saw spindles, and mounted on a separate transverse slide, are three boring heads which are adjustable to suit the spacing of the hinges for iron work. The two saw spindles and machine cut spur gearing from a common shaft connected by a flexible coupling to an electric motor.

The travelling table is made in two sections, the upper part of which forms a jig which can be changed to suit the size of door required. The lower part of the table is furnished with rollers. Each jig is fitted with two side screw cramps and a fence for holding several battens together, and also with a series of quick-acting cramps for securing the hinges or iron work in their correct position, the hinges serving to hold the timber down on the table. In operation the battens forming the doors or sides are assembled on a jig or carriage and the hinges are placed in position over the pegs, which are provided for locating purposes. The cramps are then closed and the work is fed past the saws which cross-cut the battens either square or on the bevel as required, the trenches being also cut on the underside when desired, after which the drilling operation is carried out. The washer-plates are now placed on the underside and several of the bolts are inserted by hand, after which the cramps are released and the complete unit, with its iron work, is secondly, fixing the hinges in position with the aid of the jigs; thirdly, cross-cutting the wagon door to a bevelled edge; and, fourthly, boring all the fourteen holes, using the hinges as jigs. All the above operations were carried out by two operators only.



RAILWAY WAGON BODY MAKING MACHINE


Fixed
Max. Doors 4-11½ Min. 1-10
Handwheel for tilting Saw
Rack & Pinion for moving Drilling Heads
Rack & Pinion for moving Saw Pillars
Removable Cutterblocks for Trenching Small Bottom Doors
4 B.H.P. Motor 1400/1500 R.P.M. with Spindle shortened
4 B.H.P. Motor 1400/1500 R.P.M. with Spindle extended
DETAIL OF DOOR CRAMPS
DETAIL OF BORING HEADS
DETAIL OF SPINDLE MOUNTING FOR SAW & CUTTERBLOCK
"THE ENGINEER"
SWAIN Sc

ARRANGEMENT AND DETAILS OF RAILWAY WAGON BODY MAKING MACHINE

the three boring heads are independently driven by electric motors. The saws and cutter blocks are carried on extensions of the motor shafts which are mounted in ball bearings, the motors being bolted to saddles to enable them to be canted by means of a hand wheel and screw. The two sawing units are bolted to a cast iron slide and are adjustable apart by means of rack and pinion gear. The boring spindles are carried on hinged or radial brackets so that the operator can adjust them at will to suit the exact position of the holes in the hinges, &c. The spindles of the boring heads are driven by a steel and bronze turned over on to a suitable stand for the remaining bolts to be placed in position.

The machine will deal with doors, &c., from 3ft. 6¼in. to 7ft. 7½in. long up to 4ft. 2in. wide. It carries saws up to 18in. diameter and cutter blocks to trench 2½in. wide. The boring spindles have a vertical movement of 8in. and carry augers with shanks ½in. by 2in.

Some idea of the amount of labour such a machine will save can be gathered from the following operations which were carried out under two minutes; first, assembling the battens on the table to form a wagon door;

The Future of Technical Institutions.

At the second annual meeting of the Institution of Chemical Engineers last week, the President, Sir Arthur Duckham, gave an address in which he said that when he was asked to participate in bringing into being one more technical institution he promptly refused. The number of existing technical institutions, societies and associations was legion, and it seemed to him ridiculous to add another. However, he consented eventually to join the small *ad hoc* Committee, and in time the Institution was launched. The new Institution had two attractions for him, the first that it might be the last straw that would break the camel of technical societies' back; the second, that it would give a definite status to the body of men who must be responsible for industrial development in the future—that is to say, the chemical engineers.

Undoubtedly, the rapid increase of knowledge had led to ever-increasing specialisation in investigation, and institutions and societies had been formed in which men and women working on similar problems may meet to discuss kindred subjects, and by personal touch help on the work of technical development for the benefit of humanity. However, if we looked at the records of any technical society it would be found that specialisation existed even there, and that comparatively few papers which were of real interest and use to all members were presented; and it would be found that those papers which were of general interest would have been of considerable value to a far larger audience than the members of the society in question. The rapid technical development that had taken place during the century had largely been the work of specialists under direction. It was easy enough to provide what the specialist required in the matter of councils, but it was to the technical administrator or director that the legion of societies and institutions became an absolute burden. It was to that class of man that we must look for efficient and economic development. It was not possible that such a man should be an active member of all such societies as catered for one or more of the lines of his activities, nor could he be expected to have intimate knowledge of the many branches of work that went to make the sum total of his responsibilities. Take, for example, a gas engineer. Properly speaking, a gas engineer should be a member of at least six technical societies, for no single society catered for the requirements of such a man, but it was impossible for him to belong to, and take part in, the activities of the several bodies dealing with his interests. Other examples could be taken with like results, and in considering such examples we must begin to realise that the present condition of affairs could not continue. The technical administrator would gradually lose interest in the general societies and would confine himself to taking part in the work of the society which specially applied itself to his own sphere. Thus, such bodies as Institutions of Civil and of Mechanical Engineers, the Institute of Chemistry, the Institution of Electrical Engineers would gradually lose vigour, and such societies as catered for station electrical engineers, gas engineers, coke oven managers, tramway engineers, sanitary engineers, concrete engineers, &c.,

would gain in vigour, because they provided, not only more valuable assistance to their members than the more general societies, but better opportunities to meet men closely interested in the same lines of work.

To what end, said Sir Arthur, were we moving? We could not go on as we are; we must attain some co-ordination between the varying societies; we must endeavour to prevent the overlapping that existed; and, above all, we must try to eliminate the large amount of redundant effort that was apparent to-day. He therefore made the following proposals with due deference:—That a Committee be appointed, composed of, say, two representatives appointed by the Council of each technical society to consider the whole question. He would suggest as a line of consideration that all members of such societies as might agree to join together could become affiliated members of the other societies in the group whose work was of interest to them, at a small annual subscription. That each society should continue, as at present, to publish its independent records of its proceedings, but that the group should publish a joint record of all papers and discussions of general interest that might be presented to any of the societies during the year. A committee representing the societies in the group should be formed to make the choice of the papers. Each affiliated member should receive the joint publication, and should have the right to attend the meetings of any society to which he was affiliated and take part in the discussions. A central building should be obtained to house the officials of the affiliated societies, containing conference rooms, libraries, reading rooms, &c., to meet the needs of members.

It might be possible to combine the existing accommodation owned by the various leading societies into this centralised scheme, and so make full use of existing premises. On considering the whole problem, one realised its immensity, and he had but touched the fringe of the subject. Nevertheless, he strongly urged the Councils of the various technical societies to consider the proposals, and to take steps to form a Committee of Investigation into the existing conditions.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

A Quiet Spell.

THE weekly meeting of the Midland iron trade at Birmingham to-day—Thursday—brought very little new business, and the dulness which has characterised the iron and steel trades persistently in this area continues. A quiet spell has now begun and little change is anticipated before the autumn demand sets in. A few inquiries have appeared, indicating an impression that prices are approaching stability and that the market is now rather favourable for advantageous buying. The market, however, was dull and generally the mood was pessimistic. Even the hardiest optimists were constrained to confess that demand left a good deal to be desired.

Steel Works Strike.

The Spring Vale Steel Works of Alfred Hickman, Limited, at Bilston, which, owing to the strike of a section of the workers, as recorded in this column last week, were last week closed down completely, remain idle, and at the time of writing there is no clue as to whether the stoppage is likely to be of long or short duration, though at a recent meeting of the workers it was intimated that the men's leaders realised they "were in for a heavy fight without quarter." The strike, which has cast a gloom over South Staffordshi e, is an unpleasant breach of the peace in an industry which has been notably exempt for many years from any serious rupture. Moreover, the Spring Vale furnaces were the only furnaces in South Staffordshire area to resume after the coal strike, and this sudden stoppage of between two and three thousand workers is calculated to have a damaging effect, apart from the serious position created by the direct loss of wages to so many families. Manufacturers in the Midlands generally hope that reason will prevail and that dissatisfied strikers will speedily devise some measures of procedure which will make it possible for the firm to open its doors at any rate to the thousands of workers who are not directly concerned in the dispute.

Staffordshire Iron Trade.

There is little movement in the Staffordshire finished iron trade. In several directions operations are being suspended or slowed down. Fortunately, one large Staffordshire concern which had decided to close down last week is still at work, a few regular customers having placed orders anticipating to some extent their future requirements. It is regretable to have to state that the local iron trade continues in a very unsatisfactory condition, and the district would be in a serious plight but for the opportunity of sharing in the steel re-rolling trade. It is even more regrettable that the outlook so far as South Staffordshire is concerned must be written down as gloomy. Only a very small amount of business accrued from the quarterly meeting of ironmasters, and for some little time past works have been drawing nearer and nearer to inactivity. What with the ordinary seasonal slackness and the absence of any countervailing demand in the way of big continuing contracts, a number of manufacturers have had to suspend production for the time being, or to run plants intermittently. Several forges have stopped altogether, and in more than one case dismantling is the order. Marked bar makers are the only section which are moderately busy. The bulk of the Staffordshire mills are re-rolling steel; competition, however, has become rather keen in this line. There are no changes in native bar iron prices, but some remarkable discrepancies are noticeable in Belgian No. 3 iron for nut and bolt making, quotations ranging between £7 17s. 6d. and £8 10s. delivered. Staffordshire iron for the same purpose at £12 is increasingly neglected.

Galvanised Sheet Prices.

The galvanised sheet mills continue well employed, though as the result of some slight falling off in the demand one concern has run short of orders for 24-gauge. In this solitary instance supplies have been offered at £18. Generally £18 5s. is quoted, and some mills that are specially well booked require £18 10s. There are fair orders for black sheets, prices of which are well maintained.

Sheet Works for Canada.

Considerable interest is manifest in this district in the acquisition of sheet works in Canada by John Lysaght, Limited, the business of which originated in South Staffordshire and is now incorporated with the great organisation of Guest, Keen and Nettlefold. The Lysaght concern already had important interests in Australia, but this is its first venture in Canada, and iron and steel masters hereabouts express their interest in the result of the venture.

Raw Iron Values.

There is no change in the pig iron situation locally. Demand continues small and values are weak. If the position does not improve within the next month further furnaces will go out of action. But there is a disposition to give time for the usual seasonal demand to develop. Nevertheless, smelters talk of effecting further reductions in output rather than submit to the pressure for lower pig iron prices. It is apparent that the slump in values has not been arrested. Some furnaces have this week been quoting a shilling per ton less than they required last week; other makers are quite stiff in their attitude, Derbyshire No. 3 being quoted at something over 90s. and Northamptonshire at 87s. 6d. There are yet others who will take 89s. and even less for Derbyshire, and quotations of 85s. for Northamptonshire are now the rule rather than the exception. It is fairly evident that producers in order, to obtain relief from their present anxieties, would shade even the prices mentioned above. There is so little demand for forge pig that quotations are nominal. Users of pig iron are looking for even lower prices. They build their hopes on further reductions in furnace coke. There is a good deal of this fuel available through the stoppage of furnaces and the steady diminution in exports, but prices appear to be fairly steady at 21s. at ovens. Some of the blast-furnaces are buying their coke from week to week, so as to be ready to shut off production if the slump gets worse. With prices falling Midland smelters who have been adding to stock for the past two months are naturally concerned at the losses which stare them in the face. Yet they hope for the turn of the tide and do not like to commit themselves to a passive policy which, apart from the expense involved, may render them unready to take advantage of any improvement in the situation when it comes.

Steel Business.

Business is quiet in the steel trade, and while the building strike is having an adverse effect upon trade, it has not prevented the negotiation of some fairly good bridge contracts chiefly for railways within the past week or two, and more work of this sort is under negotiation. The railways are still wanting rather large quantities of steel, but the buyers naturally want to be satisfied that something like staple prices have been reached. Any slight upward movement it is considered would be followed by the giving out of considerable tonnages of work. Steel values, however, tend to weaken rather than improve, and most finished steels of English manufacture can be shaded in price. Semi-finished steel is not much in demand, re-rollers' stockyards still being congested with heavy consignments of foreign steel which must be used up before buyers re-enter the market. There has been a little easing of continental prices this week. Billets have been bought at £6 15s., £1 less than the price asked by producers at home. Mild steel scrap is weaker, sales having been made as low as £3 18s. delivered. Foreign scrap imports maintain considerable volume and are utilised by steel works anxious to cut down their costs of production. Profit making in the steel trade is now approaching the vanishing point.

Less Continental Material.

Manufacturers of iron and steel in the Midlands and Staffordshire consider the setback shown by the import and export figures during June disappointing. The contraction of the iron and steel trade was more pronounced than the incidence of the Whitsun holidays and other circumstances affecting the comparison can explain. Nor can the displacement of British products by foreign be accepted as a conclusive reason. In some directions foreign competition was no doubt more aggressive. Belgium has been offering iron and steel on a larger scale, but, measured by our own imports, trade in continental iron and steel suffered a relapse in June. The United Kingdom took only 5584 tons of forge and foundry pig, against 14,933 tons in the previous month. The basic pig landed at our ports amounted to 9912 tons, against 22,092 tons. Our total imports of iron and steel and manufactures thereof declined from 300,067 tons in May to 175,476 tons in June. The check in the big purchases of pig iron and semi-finished steel has caused buyers here to pay more attention to the situation, and they are now watching the position very carefully, in doubt whether the time has not already arrived to place orders, if the most favourable moment is to be seized.

Fall in Exports.

The fall in exports of iron and steel during the month of June was substantial, though it was not so pronounced as that in imports. It amounted to about 20 per cent. In May 406,919 tons were exported, the largest tonnage for a year. Last month the total was 324,432 tons, 12,000 tons below the April total; but considerably better than that for March. Pig iron shipped abroad declined on the month from 75,749 tons to 40,792 tons. Reduced exports to Germany, Belgium and Italy were the principal cause of the diminished total. The United States took only 1085 tons, against 5355 tons in May. Ferro-alloys dropped from 10,548 tons to 5740 tons. Most of the main categories of finished material were affected by the falling off of demand, the only exceptions being hoops and strips, plates and sheets not under one-eighth of an inch thick, wrought tubes, pipes and fittings, bolts and nuts, and manufactures of cast iron.

The Shrinkage of Production.

The June record of iron and steel production puts into figures the shrinkage of output of which everyone was aware. Steel ingot output during the month totalled 651,500 tons, against 809,700 tons in May. Pig iron dropped during June to 607,800 tons, a fall of 33,000 tons, the figure comparing with a pre-war advantage of 855,000 tons. The total number of furnaces in blast—185—is the lowest total since January, 1923. As to figures of steel production, it is well to remember that they are still well above those of July and August last year, when steel ingot tonnage fell to 639,500 and 567,500. The prospects of trade recovery in steel business in the autumn are generally considered quite as good as they were a year ago.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

ALTHOUGH one finds very little business being done on the Manchester Exchange this week, there appears to be a slightly more cheerful feeling, and a belief that perhaps after all we may not have to wait longer than until the late autumn for a change in trade and a less depressing outlook. One cannot find any very definite reason for this change in feeling, and, of course, it would be rash to rely upon it, and to suppose that an improvement was bound to come this year. There are many difficulties in the way, and one fears that those who take a cheerful view are inclined to under-estimate these difficulties; but no doubt if the German "reparations" trouble can be settled, the Ruhr industries restored, and some success obtained in the stabilisation of exchanges, the elements of an improvement in commerce and industry will be present.

Metals.

In the copper market prices have been kept fairly steady, and there has been rather more buying in this district, apparently under the impression that prices for refined copper are now at the bottom. There is, however, still a good deal of doubt as to whether the Americans mean to continue the policy of restricting output to an extent sufficient to counterbalance the falling off in consumption. If this determination is maintained, no doubt the market is now safe for buyers, even although the European demand should remain small, as at present. Stock Exchange movements in America have suggested lately that a more favourable opinion of copper is growing there; but if it be true, as rumoured, that in future the official monthly statistics of stock and production are to be withheld from publication, one cannot forget that vague unofficial reports are far more disconcerting to any market than even unfavourable official and reliable statistics. The suppression of information always conveys the idea that the information is bad. In Manchester best selected ingots have been sold by merchants at £68 10s. per ton, and this is rather above the level of last week, although there is not much difference. The fact is that prices here have been almost unchanged for nearly two months, and this steadiness naturally engenders a certain confidence. What is wanted by the engineering trade is more moderate prices for manufactured copper and brass tubes. In tin there has been greater strength of late, and the growing disposition of American consumers to take more interest in the market has had the expected stimulating effect. There has not been much buying on this side; but this would no doubt follow so soon as American demand began to force up prices seriously. The only doubt about America is whether or not the tin-plate trade there is now on the decline; but, in any case, large quantities of tin will be required for it. The local demand for tin is very small, and apparently buyers here are content to take just what is necessary from week to week, and to pay whatever price may happen to be current at the time. In lead we have had a fairly steady market here, and apparently the squeeze in prompt metal is not yet over. One would think that it cannot be long before present prices were modified, for America is sending over lead fairly freely, and as the domestic demand is lessening she should soon be shipping large quantities. Spelter remains a very quiet market, but although trade is dull one cannot believe that spelter prices are likely to fall. Zinc sheets are certainly cheap enough to cause the regular users of galvanised iron to think about them.

Pig Iron.

The market here for foundry iron remains very quiet, but so far there has not been any decided fall in the prices. Cleveland iron has been on offer here at slightly under 100s. per ton delivered, but so long as it does not fall any more it will not interfere at all seriously with the Midland iron in Manchester. Cleveland is, however, now a cheaper foundry material than Derbyshire in Blackburn, Preston, and the more northerly parts of the county; and, as a consequence, the range of the Midland foundry irons is more restricted. It is this and not direct competition in Manchester which is weakening the Midland pig iron position, and is, of course, a good reason why consumers here keep off the market in the hope of lower prices. Apparently about 97s. 6d. delivered is the usual quotation here for No. 3 Derbyshire; but it is reported that some sellers are cutting the price. There are cases where the production has to be turned into cash without delay, and it is probably these cases which give rise to reports of lower prices. Business in foundry iron seems to be confined to small lots for prompt

delivery. One cannot hear that there is yet any improvement in the volume of business in new castings, and it is possible that a good deal of work which used to come to Manchester and the district when Cleveland iron was dear, is now going back to the old sources of supply. At any rate, foundry business here is the reverse of brisk. Scotch pig iron remains practically unchanged, but the difference of nearly 15s. between Scotch and common iron here keeps down the consumption of the former. Hematite iron is easy, or, at any rate, this is so with the East Coast brands. The West Coast hematites remain comparatively dear.

Steel.

The demand for manufactured steel, with the exception of sheets, is just as poor as ever. Steel works are rather inclined to boast of their orders for sheets, but, of course, we all know that the enormous capacity of our works cannot be occupied unless a much better demand sets in for ship-plates, joists, angles, rails and other heavy stuff. Selling agents here are very despondent about the business in joists and angles, and it is difficult to say what sort of concession would be made to secure a big order if such a thing were in the market. The nominal prices are unaltered, but there is no occasion to reduce them because this would not help while business is absent. The nominal price here for steel joists is £9 10s., but it has been reported that foreign joists have been sold recently at £6 5s. f.o.b. This gives some idea of the enormous gap between British and foreign steel, and the fact is ominous for our export trade.

Scrap.

The demand for steel scrap is rather worse than it was last week. Sheffield users of steel-making material can now buy basic pig iron at 85s., and when they want scrap for melting purposes they will expect to buy it at the same price, and, at any rate, not at any higher price. This means that the Lancashire dealer must not pay more than 75s.; and it is said that some dealers are offering only 70s. at a Lancashire station. The weakness of foundry iron is affecting the cost of scrap prices, and down to 85s. has been reported for good lots of foundry scrap. Very few foundries are in the market, and the competition for orders grow keener. Wrought scrap is getting weaker, and the Lancashire ironworks are not nearly so willing to buy as they were. No doubt the comparatively high prices in Lancashire for iron are restricting sales; and, of course, forge iron is now nearly 5s. cheaper than it was a few weeks ago. It is, however, not so much cheaper forge pig, but a lack of orders for bar iron which is keeping the ironworks off the scrap market. About 95s. per ton for heavy wrought scrap seems now a fair price.

Manchester Association of Engineers.

On Thursday, the 17th inst., a party of about sixty members of the Manchester Association of Engineers, including the president, Mr. Herbert Bates, M.I. Mech. E., paid a visit to the carriage and wagon works of the London, Midland and Scottish Railway Company at Derby. In the unavoidable absence of Mr. R. W. Reid, the chief carriage and wagon superintendent, the visitors were conducted round the works by Mr. E. J. H. Lemon, divisional carriage and wagon superintendent, and his staff. In the short period at the disposal of the visitors it was impossible to study in detail the methods of manufacture in vogue in an establishment which is spread over such a large area and finds employment for about 5000 hands, but sufficient was seen to enable those interested to learn to what a remarkable extent work of this character can be carried out by mass production processes. The members were particularly impressed by the methods adopted in assembling the parts of goods wagons and passenger coaches, less than half an hour being the average time taken for the erection of a wagon. Such celerity can, of course, only be achieved by great accuracy in the manufacturing departments coupled with the grouping and linking up of the erection operations, of which there are ten in the case of wagons. By similar methods the building of passenger coaches has been expedited to an almost incredible speed, the actual building time of coach bodies now being as many days as it formerly required weeks. At the conclusion of the visit the members were entertained to tea.

New Fire-resisting Material.

On Wednesday last, the 23rd inst., I was present at a demonstration given at the works of D. Anderson and Sons, Limited, Trafford Park, with a view to testing the fire-resisting qualities of a new roofing material made by this firm. Bitumen, as is well known, is extensively used in roofing felts, insulating materials, and for other commercial and engineering products, but it is inflammable as well as unstable. By being unstable, it is meant that bitumen is liable to soften under certain conditions and temperature of atmosphere and under very high temperatures it will melt and become liquid. After several years' research Mr. R. O. Child, Messrs. Anderson's chemist, claims to have discovered a means of rendering bitumen to all intents and purposes non-inflammable and stable, and the experiment which was carried out on Wednesday last was intended to prove whether or not he has succeeded in his efforts. For the purpose of the experiment three contiguous buildings had been erected, the first being roofed with tiles, the third with slates, and the centre one with the new bitumen roofing felt. The two end buildings were set on fire simultaneously with the object of showing first that the bitumen roof between them would not ignite from the outside. Afterwards the building roofed with bitumen was ignited from within to demonstrate that even in direct contact with the intense flame the bitumen roof would remain intact. The heat in direct contact with the roof was so high that even the glass windows in the buildings were melted. The demonstration was completely successful from both points of view. Practically the whole of the woodwork consisting of the doors, rafters and roof lining was consumed, leaving the roofing felt intact. Moreover, water was poured on the heated roof to ascertain whether it would crack or break, as is the case with heated slates and tiles when suddenly cooled by water; but the cooling had apparently no ill effect on the roofing felt, which was cool enough on the outer side to be touched by the hand. The experiments would seem to suggest that this new material might be used to advantage for dwelling-house roofing purposes, being cheaper and at least equally as safe as tiles or slates. At present, however, bitumen roofing in plastic form is not considered by many local authorities to comply with their by-laws.

BARROW-IN-FURNESS.

Hematite Still Dull.

There is little life in the hematite pig iron market. It does not differ from other markets in the country in that respect, and there is also a similarity as to the future which is doubtful. In the words of one maker of iron they just keep going, and that is about all there is to say. There is a small demand, and all inquiries are for moderate or small deliveries. There is no tendency on the part of buyers to place orders for forward delivery, and everything seems to point to the fact that the price of iron to-day is too high to tempt heavy buying. The costs of production remain high, and no one can say when they will come down. At present the producer is left little or no margin. If customers are going to wait until iron comes down in price then there is going to be an unsatisfactory time for the iron producers. There is about the same demand on home account, and there are deliveries to Scotland and the Midlands which are small. During last week there was a dispatch of pig iron to Antwerp, but the quantity was not large, and it must not be taken as a sign that continental trade is waking up. At present it is very dull and will continue to remain so with the rates of exchange as they are.

Iron Ore.

The iron ore trade is just a reflection of the iron trade, and in view of the small number of furnaces in blast in the district there is no briskness in the ore trade whatever. Foreign ore is in small demand, and the imports are kept low.

Steel.

The steel trade is quiet and not sufficient to keep all departments going regularly. The rail mills at Workington are engaged off and on, but there are not sufficient orders to keep them going regularly. At Barrow the rail mills are still working, but the merchant mill is stopped; in fact, it did not work a full week last week. The hoop and small section mills are better circumstanced and will be regularly employed. Foundries are moderately situated. There was a small shipment of rails from Barrow to Annalong last week, part of an order executed by the Barrow mills.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Trade Stagnant.

No improvement can be recorded this week in the heavy steel branches in Sheffield, Stocksbridge, Parkgate, Rotherham and Penistone. Indeed, if anything, conditions are worse. Business has fallen off until it has reached an almost negligible amount, and a large proportion of the open-hearth furnaces is now idle. There are no signs of any immediate improvement, and buyers of billets appear to be without any incentive to come into the market. Several North Lincolnshire blast-furnaces have been closed down. This slump in the iron and steel trade does not appear to be local in character, for reports to hand indicate that other centres are finding themselves similarly placed. With managers and buyers entering on their holiday season and with stocktaking also in progress, it is very improbable that there will be any change for the better until the beginning of autumn at the earliest. Prevailing conditions are of a most unsettling character as regards prices. In some quarters buyers are inclined to believe that there will be further reductions, but the makers, on the other hand, only have to point to the unproductive nature of last year's business—viewing it generally, that is to say—to show that at present figures they are barely covering their working expenses. Unfortunately, fresh labour trouble is threatening in the iron and steel trade in the Rotherham and Stocksbridge areas. Eight trade unions are concerned in a demand by semi-skilled workmen for a wage increase, and unless the dispute is settled by the end of next week drastic action is threatened.

Lighter Steel Sections.

There is a very active demand for motor car steel, and this is one of the busiest departments in the city. The steady increase in the requirements of the motor trade are bringing more and more orders for steel parts to Sheffield, and the city is turning out a product of a very efficient quality. Many firms are able to rely on regular periodic orders, and at present there are many extra orders arriving which are keeping the works pretty well up to their full output. More orders are to hand for saws and files for Russia, and these goods are also meeting with a brisk demand from other oversea countries and from the home markets. Tools are in slightly greater request, and there is a brighter outlook for agricultural, mining and quarrying machinery and parts. The shipyards are also asking for deliveries of bigger supplies.

Cutlery and Plate.

The cutlery and plate branches continue to maintain the improvement noted last week. Most of the works can show more favourable order books, particularly those producing the cheaper classes of goods. These goods are being sent away in very large consignments, but the profits are on the light side, quotations generally being cut to a very fine point on account of the keenness of competition. Those firms which refuse to make anything but goods of the highest quality have been having a lean time for many months, but they are now able to report that conditions are improving, less difficulty being met with in securing orders. The Dominions are proving good customers, particularly Australia, which is placing substantial business in Sheffield. A visit to the city has been paid this week by Mr. F. W. Field, Senior Trade Commissioner for Canada, who came to have a chat with manufacturers and traders and to give them the benefit of his advice and experience. Mr. Field states that, although trade with Sheffield has been rather quiet of late, a slight improvement appears to have set in. It is hoped that this revival will be assisted by an encouraging harvest. Canada's chief requirements to-day are capital to develop the natural resources and population for agricultural production. Mr. Field further points out that edge tools and cutlery to the value of about £1,200,000 are produced annually in Canada. The cutlery goods are chiefly razors and blades and these, as well as knives, are made from Sheffield steel. Sheffield manufacturers will be particularly interested in his statement that recently there was a large holding in stock in Canada of Sheffield cutlery.

Coal Under Sheffield to be Worked.

In my reference last week to the application by the Nunnery Colliery Company, of Sheffield, for power to work minerals under the Mines (Working Facilities and Support) Act, 1923, I mentioned that the Court had agreed to sanction the working of the coal under Sheffield, but that it was considering one or two other points. These points have now been settled, and a summary of the Court's order as to the method of working the minerals is as follows:—That a proportion only of the coal should be extracted and the remainder left in to form permanent pillars for supporting the surface; that the consideration to be paid by the applicants should be £150 per acre for the Silkstone seam and £80 for the Parkgate seam, any difference arising to be referred to the Commission; that the term during which the coal may be worked should expire on October 1st, 1941; that the applicants should work the coal in a proper and workmanlike manner. The Order also contains clauses to guard the interests of the property owners and the public. It is estimated that it will now be possible to raise 3,000,000 tons of coal which otherwise would not be got. As the application is the first of its kind the decision will be noted with great interest by mining engineers and colliery proprietors.

Reservoir and Water Schemes.

Leeds is considering proposals to construct two new reservoirs in the Laver Valley. Authorisation for these works was given some years ago, but up to now nothing definite has been done in the direction of getting on with them. Leighton Reservoir, which, it is expected, will be ready for filling in the winter of 1925, was to be the first of a chain of four reservoirs in the Ure Valley, and some 6 miles south-east of Leighton are the sites of the proposed new reservoirs at Carlesmoor and Laverton. An alternative site at Colsterdale—adopted twenty-three years ago—has not been abandoned, but the order of construction of the two works is going to be transposed. Leeds Water Committee's chairman states that they are going to take first the one that gives the bigger yield, as by so doing he believes they will get a cheaper reservoir per million gallons contained. The proposed new Colsterdale Reservoir is designed for a daily yield of 3¼ million gallons, while the Carlsmoor or Lavet Reservoirs are designed for a yield of 5½ million gallons. A proposal is now being considered for covering three Bradford service reservoirs in order to prevent deterioration and contamination of the water after filtration. Nineteen tenders have been received for the work. The estimated cost is £10,000, and the tenders range from £7220 to £13,812. The Bradford Water Committee has chosen the tender of John Dickinson and Co., of Bolton (£11,886), for the erection of a pressure filter house at Thornton. Still another water scheme in the West Riding concerns Wath Urban Council, which has asked the Ministry of Health for sanction to borrow £10,227 for the installation of new plant at the waterworks and other developments of the undertaking. Duplicate machinery is needed, as under present conditions half the district would be without any supply in the event of a serious breakdown. The storage accommodation is also inadequate.

Sewage Disposal Works.

Wath Council is further asking for permission to spend £8490 on sewerage and sewage disposal. Warsop Urban Council has received the necessary sanction for a loan of £12,346 for works of sewage disposal, and Messrs. Vallance and Westwick, of Mansfield, have been appointed the engineers for the scheme.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE trade position generally in the North of England is very discouraging. A wave of depression seems to have come over almost every branch of industry, and particularly is this the case in the iron and steel trades. These industries are passing through a very trying period, and no improvement can be looked for yet awhile as the holiday season is upon us. The outlook, however, is not entirely hopeless. After all, the London Conference, it is to be hoped, is about to be crowned with success, and the conclusion of a final settlement with Germany cannot fail to be immediately beneficial to the iron and steel trades, even though Germany hereafter may prove to be a formidable competitor. Even in that aspect we can hardly be worse situated than at present, for the export trade has fallen away considerably, and the condition of international trade could hardly be worse.

Cleveland Iron Trade.

Extreme quietness continues to characterise the Cleveland pig iron trade. This condition is not unusual at this period of the year, and producers recognising this fact do not look for a return of activity until towards the end of next month, when consumers should begin to make provision for autumn requirements. At present home sales are on a very limited scale, and the state of the foreign exchanges continues to hold up overseas trade. Continental competition is keen, and is felt most as regards semi-finished material, substantial quantities of which have been bought abroad for use in this district. Foreign producers are also underselling Cleveland makers in markets at a distance. Notwithstanding the unsatisfactory conditions, however, Cleveland makers are loath to make concessions. No. 3 G.M.B. Cleveland pig iron is quoted at 87s. 6d. per ton for export, and 87s. per ton for home delivery. No. 1 foundry iron is so scarce that it is kept at 92s. per ton, and No. 4 foundry and No. 4 forge are still 86s. and 85s. per ton respectively.

Hematite Pig Iron.

The projected stoppage of two hematite furnaces in this district has not yet taken place, and consequently there are at the moment 16 blast-furnaces producing East Coast hematite. It is more than enough to meet the needs of the market, and stocks are increasing even though makers are now accepting 94s. 6d. per ton for mixed numbers and 95s. per ton for No. 1.

Ironmaking Materials.

There is no movement in the foreign ore trade. Sellers still base their quotations on 23s. per ton c.i.f. Tees for best Rubio ore, though recent sales are understood to have been transacted at less, and it is difficult to discover on what terms contracts might be arranged. Sellers of good Durham furnace coke still quote 27s. per ton delivered at the works, but buyers are not disposed to pay so much.

Manufactured Iron and Steel.

There is no material change in the position of the manufactured iron and steel trade. The demand for galvanised corrugated sheets is unabated. Japan, South America, South Africa, and Australia are as keen as ever to purchase sheets, but makers are so fully booked that they cannot enter into further contracts for delivery much before the end of the year. There is a moderate demand for shipbuilding material, but generally local output is down 20 per cent. Manufacturers of most other descriptions of material are short of work. Prices still remain unchanged nominally, but can in many instances be shaded.

The Coal Trade.

The Northern coal trade is passing through a very anxious time, and there is, unfortunately, nothing in the outlook to warrant hopes of an early recovery. All producers are badly in need of trade. There is a large number of mines idle for lack of trade throughout Northumberland and Durham, while numerous others are only working two to three days per week. In many instances this week notices have been given to workmen to terminate their engagements. There is always the hope, however, that business will turn up to obviate the notices taking effect. All the same, the depression is severe and without any encouraging symptoms at the moment. Recent prices are quoted as producers are unwilling to make further concessions, and so when current figures fail to secure trade there is no alternative but to lay pits idle. The demand from the Continent has fallen to a very low ebb, as a result largely of the fact that German coal is being offered at 1s. to 1s. 6d. per ton less than some local qualities. The Northumberland steam coal market is irregular, best qualities being moderately booked and stemmed for the next week or so, but all other grades of steams, including unscreened and Blyth and Tyne smalls, are freely offered at recent minimum prices. This is usually the slackest period of the year for gas coals, and consequently the demand is dull. All Durham grades are plentifully offered at late values, and all the pits are in need of urgent trade. Coking coal is also stationary, and values quoted are difficult to obtain for any grade or date of shipment. There is a fair trade for gas coke, but other makes are quiet and supplies are ample to meet all requirements.

SCOTLAND.

(From our own Correspondent.)

The Annual Holidays.

THE annual holidays are now being observed. In busy times the summer vacation comes as a welcome respite, but in view of the state of business at present a feeling of relief is much more prevalent this year. Officially speaking, the holidays end on Monday, the 28th inst., but in many cases the vacation will be extended.

Past and Future.

The past six months have been a comparatively dismal period in some industries. Buyers have only been able to purchase on very restricted lines owing to the unstable condition of markets, due in a measure to labour unrest. The many demands for higher wages and threatenings of strikes produced a feeling of uncertainty that has been difficult to dissipate. Costs of production have been maintained at a high level partly from the same reason, while guarantees of delivery have been almost impossible. For some weeks, however, a slightly better feeling has prevailed, and it is hoped that more general activity will be noticeable soon after the holidays. The position at the shipbuilding yards is improving, and the local steel and ironworks are hopeful of reaping a substantial amount of business in the autumn. The difficulty in reconciling makers' and buyers' ideas of prices has not been overcome yet, and offerings of cheap continental materials have not been a helpful factor in this respect. The inactivity of foreign markets has been severely felt, and consequently it is somewhat gratifying to note some movement in this direction. The outlook cannot be regarded as promising, but there is a hopeful feeling that the early autumn will witness a considerable increase in trade all round.

Steel and Iron.

The majority of the steel works have a fair number of old contracts on their books, but specifications to replace them have been extremely slow to materialise. Shipbuilders and others have been utilising cheaper continental material wherever possible. Steel plates and sections have a neglected appearance compared with former times, and only in the light sheet department is activity of a substantial character to be met with. Light sheets have been extensively bought on foreign account and also for Dominion consumers, and business has been done over the last three months of the year. Galvanised descriptions are particularly busy and an even firmer price than £18 10s. per ton for 24 B.G. has been done. Bar iron makers are not particularly well placed and have not much business on hand over the holidays. The re-rolled steel department of this industry is similarly placed. The pig iron market has been without feature. The demand for hematite and foundry iron has been decidedly poor and a weak tone has been prevalent.

Coal.

No improvement was noticeable in the coal market and comparatively idle conditions continued right up to the holidays. West of Scotland fuels were on offer at low prices, with the exception of splints, which maintained a degree of firmness owing to shipments falling due. Inquiries were few in number and small in bulk, while forward negotiations were still absent. Collieries in the Lothians and Fifeshire are hard hit by the scarcity of foreign orders, and in the latter district idle time is much more prevalent. Aggregate shipments amounted to 256,204 tons, against 295,409 tons in the preceding week and 161,503 tons in the same week last year. The home market has been correspondingly idle. Usually just before the holidays there is at least a mild rush for fuel, but nothing of this nature was experienced this year. Home consumers are working off stocks before purchasing more.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE position has not altered to any appreciable extent so far as the steam coal trade is concerned, except that at the moment of writing the tonnage situation is better. Whether or not it will remain so is uncertain. There should, of course, be rather more loading pressure during the next week or so, in view of the holidays during the first week of August, when production will be curtailed by about half. It is for this reason that collieries are not selling ahead at the prices which many of them are disposed to accept for prompt loading, as the market for immediate supplies is full of irregularity. The conditions have undoubtedly been almost as bad as they could possibly be owing to the paucity of inquiry and the lack of ready tonnage. Last week there were far more empty loading berths than there were steamers waiting for their turn, and the consequence was that collieries were placed in difficulties for wagons and were compelled to make concessions in prices which in many instances were below the cost of production. This week the tonnage to hand is better, and for once in a way there are more steamers waiting for berths than there are berths available, but whether this situation will be reversed before the end of the week it is difficult to say. The inquiry from abroad is still very limited and the conditions are altogether dull, but there are indications of an improved demand, though they are slight.

Miners and Unemployment.

Work in the coalfield has been very irregular, and at quite a number of collieries the men have not worked more than about three days a week of late. The outlook for many of the miners is far from bright, as last week-end notices were served upon them to terminate their employment in fourteen days' time. This is the case at the International Pits at Blaengarw, which affects about 1200 workmen, while several hundred men in the Aberkenfig district are similarly affected. At Abercynon about three thousand men have received notices to terminate their contracts, these men being employed at pits belonging to Messrs. Guest, Keen and Nettlefold. All these notices have been served purely on account of the slackness of trade; but there is further trouble looming, as there is a strike in the Rhondda area threatened on Saturday next, which, if it materialises, will mean that about 40,000 miners will be rendered idle. The trouble is the result of the campaign against the non-unionist. The notices were recently tendered, and at a meeting held on Monday it was decided that the notices should take effect and the whole district should become idle unless the whole of the lodges were able to show 100 per cent. membership. In the meantime a campaign against the defaulters is being waged throughout this week, and upon its success depends whether there will be work or not after Saturday.

Iron and Steel Trade.

The conditions in the iron and steel trade in this district leave room for improvement. In the early part of last week the position at the Ebbw Vale Company's works was that a stoppage was threatened on account of non-unionist trouble. Later in the week the strike of between 300 and 400 skilled men was called off, but that fact has not averted the suspension of work. When the men presented themselves for work on Thursday morning of last week they were informed that there was none for them owing to the shortage of orders. The Top Mills and Siemens furnaces, together with the sheet mills, are being operated, but the blast-furnaces have been damped down and the steel works closed. Altogether about 1500 men are affected by the stoppage.

Wages in Ship Repairing Industry.

Reference has been made to the negotiations which have been proceeding for some time regarding the demands of workmen in the ship repairing industry for increased wages. The boilermakers have now accepted the advance offered of 2s. 6d. per week on time rates as from July 16th and a further increase of a like amount to operate as from October 1st. This increase is the same as that offered to the skilled and semi-skilled allied trades. The fitters have, however, refused the employers' offer.

Trimmers' and Tippers' Hours of Work.

Representatives of the employers concerned in the shipment of coal at South Wales ports met the representatives of the workmen during the latter part of last week to discuss the question of arranging for the provision of additional working hours to meet the needs of trade as they arise. No decision was come to except that further information should be prepared by the employers in support of their arguments for extended working hours and passed on to the workmen's side, after which there will be a further conference to discuss the position.

Current Business.

There has been a paucity of orders for prompt shipment and the market has been extremely uneven. Best Admiralty large have continued to be the relatively steadiest section on the basis of 28s. to 28s. 6d., but other grades have been very plentiful and easy. Steam small coals have been a glut on the market, and the supplies of these alone have been sufficient to interfere with the regular working of some collieries. Patent fuel and coke have shown no change, while in the anthracite section some of the sized qualities have been firm and scarce, but otherwise the market has presented no feature.

LAUNCHES AND TRIAL TRIPS.

TULLOCHMOOR, collier; built by Blythe Shipbuilding and Dry Dock Company, to the order of Walter Runciman and Co., Limited; dimensions, 330ft. by 43ft. by 27ft.; to carry 4050 tons. Engines, triple-expansion, 23½in., 38in., 64in.; constructed by North-Eastern Marine Engineering Company; launch, July 3rd.

CEDARBANK, motor ship; built by Harland and Wolff, to the order of the Bank Line, Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; gross tonnage 5200. Engines, two sets of six-cylinder Diesel engines; constructed by the builders; launch, Monday, July 7th.

BRITANNIA IV., motor passenger boat; built by John I. Thornycroft and Co., Limited, Southampton, to the order of the Britannia Boat Company, of Southend-on-Sea; dimensions, 109ft. by 20ft. and 2ft. 6in. draught; to carry up to 500 passengers. Engines, two sets of 75 brake horse-power six-cylinder paraffin engines; constructed by the builders; launch, recently.

MARUDU, motor ship; built by Workman, Clark and Co., Limited; to the order of Straits Steamship Company, Singapore; dimensions, 275ft. by 41ft. 6in. by 20ft. 6in.; to carry 350 passengers. Engines, six-cylinder, four-stroke, single-acting Diesel engine; constructed by Burmeister and Wain; trial trip, Tuesday, July 8th.

SILVERLARCH, single-screw motor ship; built by Swan, Hunter and Wigham Richardson, Limited, Wallsend, to the order of the Mount Steamship Company, Limited, of London; dimensions, 400ft., 55ft. 3in. and 28ft. 8in.; to carry 8400 tons deadweight. Engines, six-cylinder reversible two-cycle single-acting and port scavenging Neptune oil engines, 2200 horse-power; constructed by the builders; launch, July 15th.

INFORMATION BUREAUX AND SPECIAL LIBRARIES.—A Conference will be held at High Leigh, Hoddesdon, Herts., during the week-end, September 5th–8th, at which the functions, future developments, and the methods and equipment of intelligence bureaux, and on their relations with other institutions, including national and public libraries, will be discussed. It is hoped to obtain representatives of such varied fields of activity as Government and municipal departments, technical and research institutions, industrial concerns, financial houses, insurance offices, newspapers, and civic and social organisations, all of which have a common interest in the collection, treatment and dissemination of facts and information relevant to their particular activities. Further information may be obtained from Mr. A. F. Ridley, Athenæum Chambers, 71, Temple-row, Birmingham.

BRITISH ENGINEERING STANDARDS ASSOCIATION.—A British standard glossary of terms used in electrical engineering is now nearing completion and will be issued shortly by the British Engineering Standards Association. A portion of it dealing with terms and definitions used in connection with telegraphs and telephones has just appeared. The definitions in this section have been drawn up in co-operation with the American Institute of Electrical Engineers and the American Engineering Standards Committees, thus ensuring uniformity in nomenclature as far as possible among telegraph and telephone engineers in this country and in America. The list contains definitions of about 230 terms, which are grouped into eight subsections to facilitate reference. An alphabetical index is also included, giving full cross references. The only other section of the glossary already published deals with terms and definitions used in wireless communication.

THE FARADAY SOCIETY.—At the annual general meeting held on July 7th, Professor F. G. Donnan, F.R.S., was elected to succeed Sir Robert Robertson as president. The annual report records considerable activity during the past year. Eleven meetings were held, and of them four were general discussions, which have become a feature of the work of the Society. The subjects were as follows:—(i.) "Alloys Resistant to Corrosion;" (ii.) "The Physical Chemistry of the Photographic Process;" (iii.) "The Electronic Theory of Valency;" (iv.) "Electrode Reactions and Equilibria." The value of the sales of the Society's "Transactions" and reprints amounted to nearly £900, a figure which is in excess of the amount received for subscriptions. The membership of this very active Society is only 432, and consequently an appeal for a larger membership is made in the annual report. Particulars relating to the Society may be obtained from the secretary and editor, Mr. F. S. Spiers, 90, Great Russell-street, London, W.C. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 0 0	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	4 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 14 6	4 14 6
No. 1	4 15 6	4 15 6
Cleveland—		
No. 1	4 12 0	4 12 0
Silicious Iron	4 12 0	4 12 0
No. 3 G.M.B.	4 7 0	4 7 6
No. 4 Foundry	4 6 0	4 6 0
No. 4 Forge	4 5 0	4 5 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 5 0	—
,, ,, Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 5 0 to 4 6 0	
,, Forge	4 0 0	—
(3) Derbyshire—		
No. 3 Foundry	4 9 0 to 4 10 0	
Forge	4 4 0 to 4 5 0	
(3) Lincolnshire—		
No. 3 Foundry	4 12 0	—
No. 4 Forge	4 13 0	—
Basic	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 10 0 (a) / 5 15 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best ,,	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 10 0	—
Best ,,	14 0 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light ,,	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
,, (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
,, (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 0 0 to 10 5 0	
Intermediate Basic	9 10 0 to 10 0 0	
Soft Basic	8 5 0 to 8 10 0	
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	7 12 6 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 15 0 to 10 0 0	
Joists	9 15 0 to 10 0 0	
Tees	10 15 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/7½ to 22/10½
Block Tin (cash)	245 10 0
,, (three months)	245 10 0
Copper (cash)	62 7 6
,, (three months)	63 7 6
Spanish Lead (cash)	32 17 6
,, (three months)	31 5 0
Spelter (cash)	32 5 0
,, (three months)	31 15 0
MANCHESTER—	
Copper, Best Selected Ingots	68 0 0
,, Electrolytic	68 10 0
,, Strong Sheets	92 0 0
,, Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
,, Condenser	0 1 2
Lead, English	34 15 0
,, Foreign	33 15 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8¼ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
,, 6 p.c. to 8 p.c. ,,	£23 10 0	8/–
,, 8 p.c. to 10 p.c. ,,	£23 0 0	8/–
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 10 0	15/–
,, ,, 1 p.c. ,,	£51 0 0	17/6
,, ,, 0.75 p.c. carbon	£68 0 0	20/–
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
,, ,, 75 p.c.	£18 10 0 scale 6/– per unit	
,, Vanadium	19/3 per lb.	
,, Molybdenum	8/3 per lb.	
,, Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£120 to £130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/3
,, ,, Ell	18/6
,, ,, Splint	20/– to 21/–
,, ,, Trebles	19/–
,, ,, Doubles	18/–
,, ,, Singles	17/–
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/3
,, ,, Splint	20/–
,, ,, Trebles	19/
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	18/– to 19/9
Screened Navigation	25/6
Trebles	21/–
Doubles	18/9
Singles	17/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	17/6
Secondary Steam	16/6
Trebles	20/–
Doubles	18/9
Singles	17/6

ENGLAND.

(3) N.W. COAST—	
Steams	30/–
Household	45/– to 58/4
Coke	33/–
NORTHUMBERLAND—	
Best Steams	19/6 to 20/–
Second Steams	18/6 to 19/–
Steam Smalls	10/6 to 11/6
Unscreened	16/– to 17/–
Household	27/–
DURHAM—	
Best Gas	21/6 to 23/–
Second	19/6 to 20/6
Household	27/–
Foundry Coke	26/6 to 27/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/– to 35/– —
Barnsley Best Silkstone	28/– to 29/– —
Derbyshire Best Brights	28/– to 30/– —
,, ,, House	25/– to 27/– —
,, ,, Large Nuts	24/– to 25/– —
,, ,, Small ,,	18/6 to 20/6 —
Yorkshire Hards	23/– to 24/– —
Derbyshire ,,	21/6 to 23/6 —
Rough Slacks	12/6 to 15/6 —
Nutty ,,	12/– to 14/– —
Smalls	9/– to 10/– —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export) f.o.b.	21/6 to 23/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	28/– to 28/6
Second ,, ,,	27/– to 28/–
Best Dry Large	26/6 to 27/–
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	26/6 to 27/–
Western Valley ,,	26/– to 26/6
Best Eastern Valley Large	25/– to 26/–
Ordinary ,, ,,	24/– to 25/–
Best Steam Smalls	17/– to 17/6
Ordinary ,,	15/6 to 16/6
Washed Nuts	25/– to 27/–
No. 3 Rhondda Large	28/– to 29/–
,, ,, Smalls	22/6 to 23/–
No. 2 ,, Large	24/– to 25/–
,, ,, Through	20/– to 22/6
,, ,, Smalls	15/– to 16/–
Coke (export)	47/6 to 55/–
Patent Fuel	28/– to 29/6
Pitwood (ex ship)	26/6 to 27/6
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	50/– to 52/6
Seconds	42/6 to 45/–
Red Vein	27/6 to 30/–
Machine-made Cobbles	57/6 to 62/6
Nuts	52/6 to 60/–
Beans	40/– to 43/–
Peas	24/– to 26/–
Breaker Duff	9/9 to 10/3
Bubbly Culm	14/6 to 15/6
Steam Coals :	
Large	24/– to 26/–
Seconds	22/– to 24/–
Smalls	15/– to 19/–
Cargo Through	18/– to 22/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England.

(7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 20/6 to 24/6; open market, 27/– to 28/–. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

The Trade Situation.

ALTHOUGH a falling off in business is a natural consequence of the holiday season, the present stagnation is so pronounced that other influences must be at work in arresting the activity which, until quite recently, was observable more or less in nearly all branches of industry. Even the motor car trade has suffered to an extent which shows that there is something radically wrong in the situation. Some firms which took orders for cars in the spring, without covering their requirements in material, now find that the prices they have to pay for special steels, together with the higher wages, more than absorb their profits, and rather than sell their cars at a loss they prefer to wait in the hope that customers will cancel orders. All this is, of course, due to the general feeling of uncertainty as to the future, which renders it very difficult for manufacturers to make provision beforehand. The London Conference contributes to the element of instability. The French are aware that they have arrived at a parting of the ways and that, whichever path they follow, there is bound to be a complete change in the situation. So long as there is no means of knowing whether the change will help or hinder trade development everyone is maintaining an attitude of prudent reserve. There is very little buying, and the orders available have rarely been so few as they are now. The one desire of makers is to avoid an accumulation of stocks until they see that the issue of the London Conference is likely to inspire confidence and bring about a general stability.

Reparations.

The question of reparations, so far as it concerns this country, is no longer limited to the provision of material for carrying out reconstruction work in the devastated regions, and as that work has been done mainly with French capital and material it is naturally argued that the German contribution in the form of raw and manufactured goods should be employed for other purposes. So far as raw material is concerned there is practically no limit to the supplies that can be taken from Germany. Coke is especially needed, and probably some arrangement will be come to with Germany for a partial exchange of coke and Lorraine iron ore. In the case of manufactured goods the prospect of any large quantities being sent into France is regarded with considerable disfavour, and it is hoped to overcome the difficulties incidental to competition, and a possible cutting of prices, by employing German iron and steel and other products in the carrying out of public works which will serve to increase the country's manufacturing resources. The programme drawn up by the late Minister of Public Works, M. Le Trocquer, for utilising German aid in the various hydraulic, canal, railway and other enterprises did not meet with any approval from the Germans themselves, and it remains to be seen whether the efforts now being made to effect a final settlement will result in some compromise that will be acceptable to both French and Germans.

Capital and Trade.

When the Colonial Governors complain that they are unable to get on with the execution of the railway and other public works which are to bring prosperity to the French colonial possessions because it is impossible to interest capital in such enterprise, it follows that industrial ventures generally can hardly expect to have more success in securing financial aid. There has rarely been a time when the banks have cut down credit to the extent they are doing now. The old system of bills at thirty, sixty and even ninety days had much to recommend it as a means of facilitating business and of enabling firms to carry on with a moderate capital, but nowadays the banks are very reluctant to discount such bills, and appear to be encouraging the system of payment by cheque, which has been growing in favour since the war. This withdrawal of credits, following upon the commercial crises of the past few years when so many firms failed, has done much to render the position of a large class of manufacturers still more precarious, and efforts are, therefore, being made to restore the system of bill transactions.

Cable Railway.

For the convenience of a sanatorium which is being installed on the plateau of the Petites Roches in the valley of the Isère, a cable railway of more than ordinary interest has just been completed. Rising to a height of 690 m., on a length of 1473 m., the railway has an average gradient of 58 per cent. Over a certain part of the route the gradient reaches 83 per cent., and at one point the line rises at an angle of 45 deg. to the horizontal. Another feature is the relatively high speed attained, as the full distance must be climbed in twenty minutes. Special precautions have therefore been taken to ensure safety in working. The steel cable, which has a hemp core, has a diameter of 1¼in., and while running normally with a maximum load of 8 tons the breaking strain on the cable in test was 92 tons. The drum is fitted with a special system of brake which stops the cars when they exceed the normal speed or go past the halts, or if there should be a failure in the supply of electrical energy. There is also a brake on the car sufficiently powerful to stop it should it become disconnected from the hauling cable.

Rice Conditioning Machinery.

The efforts being made by the French to secure the rice trade in Indo-China, which was formerly in the hands of the Chinese, has had the inevitable result of creating a propaganda in favour of importing rice conditioning machinery of French manufacture. At present the whole of the plant is obtained from Germany and Great Britain. Some French firms have already tried to manufacture such machinery, but were obliged to give it up through the impossibility of competing with foreign makers who controlled much larger markets.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 28, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

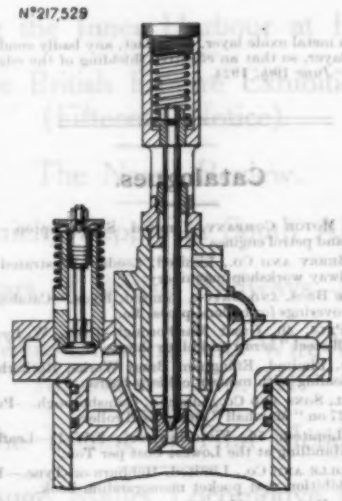
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

217,529. February 6th, 1924.—CYLINDER COVERS, Swan, Hunter and Wigham Richardson, Limited, Walker, Newcastle-on-Tyne, F. Rowntree, 3, King's-road, Monkseaton, and P. Belgavin, 13, Otterburn-terrace, Jesmond, Newcastle-on-Tyne.

This invention relates to the cylinder covers of internal combustion engines and to the valve arrangements associated with such covers, the chief object of the invention being to provide a construction of cover, with the associated valves, which reduces the stresses due to heat action and enables the cover to be made in a symmetrical manner at the portion subject to the

N°217,529



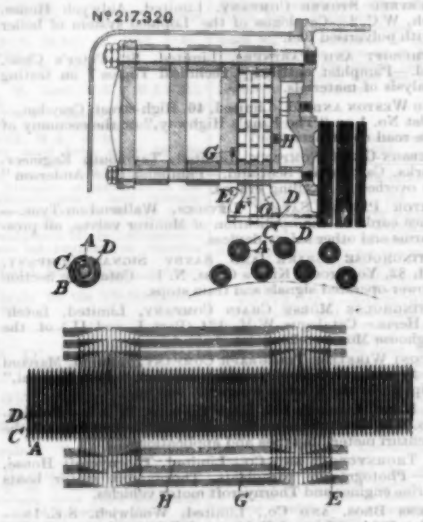
working pressure and to high temperatures. The inventors consequently mount a water-cooled fuel valve body in a central recess in the cylinder cover—as shown in the drawing—leaving around the inner end of the valve body a narrow annular clearance surrounding part of the water jacket and opening into the combustion space, with which clearance the valves other than the fuel valve communicate. The fuel is, therefore, injected or admitted in the centre of the cover, while the communication between the other valves of the working space of the cylinder is in the form of a symmetrical annular passage around the fuel valve, so that complete symmetry is obtainable at the part of the cover specially subjected to heat stresses.—*June 19th, 1924.*

DYNAMOS AND MOTORS.

217,320. March 14th, 1923.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINERY, TRANSFORMERS AND THE LIKE, Sir Charles Parsons and Jessel Rosen, both of Heaton Works, Newcastle-on-Tyne.

The object of this invention is to enable alternators to be built for higher voltages than usual. The conductors are circular in cross section, and consist of a central core A, which carries the current at the highest voltage. These coils are surrounded by a pair of conductor tubes C and D, with intervening insulation

N°217,320

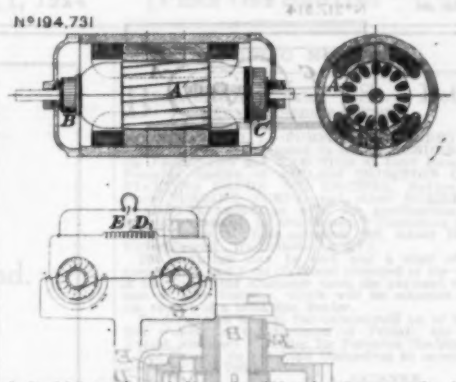


B, and these conductors carry lower voltage current. The conductors A C and D are connected to the windings, only one phase of the winding being shown. The inner cores of the various conductors are connected in series, and then connected by the cross connector G to the surrounding conductor tubes C, which are again connected in series, and so by way of the cross connection H to the outer conductor tubes D, which are connected to the earthed end of the winding, as indicated at E. The voltage between adjacent conductors and between the outer conductor and earth is thus kept at a low figure, so that the necessary thickness of insulation and length of leakage surface can be provided without unduly increasing the dimensions of the plant.—*June 16th, 1924.*

194,731. March 13th, 1922.—IMPROVEMENTS IN AND CONNECTED WITH DYNAMO-ELECTRIC MACHINES, *Société Anonyme Electrolabour and Georges Adolphe Esconflaire, of 79, Rue Saint Blaise, Paris.*

Generators constructed in accordance with this invention are small and light, and have an efficiency of 80 per cent., and currents at high pressures, such as 1000 or 1500 volts, can be obtained in a simple manner. The currents are also free from harmonics. The armature slots A are almost closed and the armature can carry several windings. In the particular case illustrated, the armature has two distinct windings insulated from one another, one being a low-tension winding, 8 volts, for example. This winding is connected up with a commutator B

N°194,731

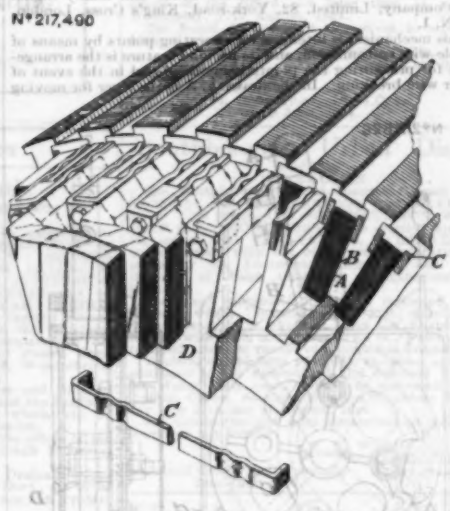


and the high-tension winding—for 600 volts, for example—is connected up with another commutator C. The two windings are composed of enamelled wire. The air gap is made very small. Moreover, the armature slots are inclined—as shown—and there is an uneven number of these slots. A large number of commutator segments is also used. The speed of the machine is from 3000 to 4000 revolutions per minute. The brushes of the two commutators are connected in series according to the lower diagram, and the field winding D is connected in shunt across the outside terminals. By listening with a telephone E, it is possible to arrive at the desired fixing of the brushes of each armature section for giving the minimum noise. A continuous current is thus obtained which is suitable for wireless telegraphy and telephony, &c.—*June 12th, 1924.*

217,490. October 12th, 1923.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.

This invention relates to dynamo-electric machines with two windings in a slotted core. Each slot has a reduced section A, in which a conductor B of a winding is placed. Conductors C

N°217,490



are also placed at the sides of the conductors B. The conductors C form a short-circuited winding, being connected to end rings D. The conductors C are shaped as shown in the lower illustration. The conductors B may be placed in position without interfering with the conductors C or the end rings. If it be desired to remove any coil formed by the conductors B, this may readily be accomplished without interfering with the conductors C and the end rings D.—*June 19th, 1924.*

TRANSMISSION OF POWER.

217,331. March 16th, 1923.—IMPROVEMENTS IN OR RELATING TO LIGHTNING OR SURGE ARRESTERS, Electrical Improvements, Limited, of Milburn House, Newcastle-upon-Tyne, and Lewis Colin Grant, of 3, Langhorn-street, Newcastle-on-Tyne.

The lightning arrester described in this specification consists of an inductance coil in series with the line. This coil constitutes the

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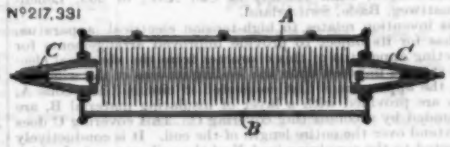


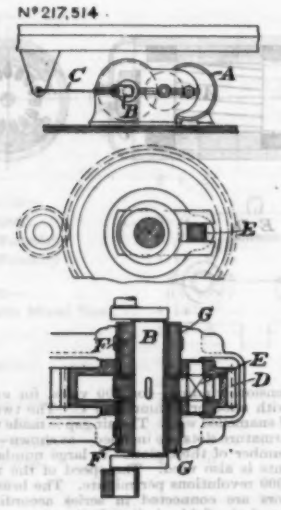
primary of a transformer and a secondary serves to dissipate the energy produced by the oscillations in the primary circuit. In the arrangement shown the surge arrester is tubular in form and consists of a transformer having as a primary an inductive coil A. Surrounding the coil A is a cylindrical tube or sheath B of resistance material, this tube B constituting a single-turn secondary for the transformer. The ends of the tube B are closed by

annular plates within the central hole in each of which is mounted an insulator C. The ends of the coil A are connected to conductors, which pass through the insulators C, and are connected at their outer ends to the line, so that the coil A is in series with the line.—*June 16th*, 1924.

CRANES AND CONVEYORS.

217,514. December 11th, 1923.—CONVEYOR DRIVING GEAR, F. Kubitza, Siemianowitzerstrasse, Bethuen, Upper Silesia, and Stephan, Frölich and Klüpfel, 24, Gartenstrasse, Bethuen.

This gear, for driving jigging conveyors, is so arranged that it is possible to regulate the varying angular speed of the driving shaft. The conveyor is driven by a motor A, through a crank

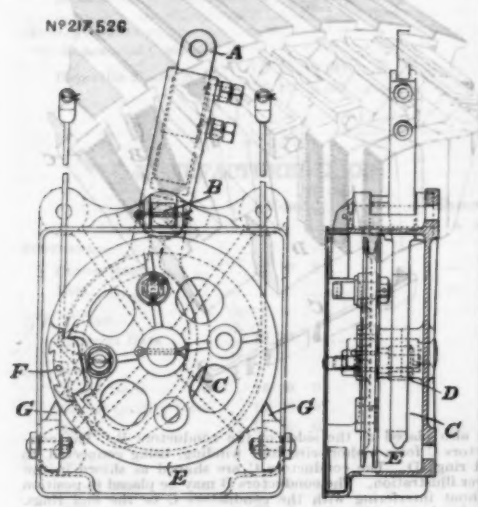


shaft B, and connecting-rod C. The motor drives the hollow gear wheel D, which, in turn, drives the crank shaft through the sliding block E. The crank shaft is mounted in excentric bushes F F, which can be turned within the excentrically bored bushes G G. With the shaft B and wheel D arranged concentrically, the connecting-rod C receives a plain harmonic motion, but by displacing the centre of the shaft a variable quick-return motion can be obtained.—*June 19th*, 1924.

TRAMWAYS AND RAILWAYS.

217,526. January 31st, 1924.—POINTS MECHANISM, A. G. Kershaw and the Westinghouse Brake and Saxby Signal Company, Limited, 82, York-road, King's Cross, London, N. 1.

This mechanism is intended for operating points by means of double-wire transmission, and its peculiar feature is the arrangement for preventing the points being displaced in the event of either wire breaking. In the drawing, A is the lever for moving

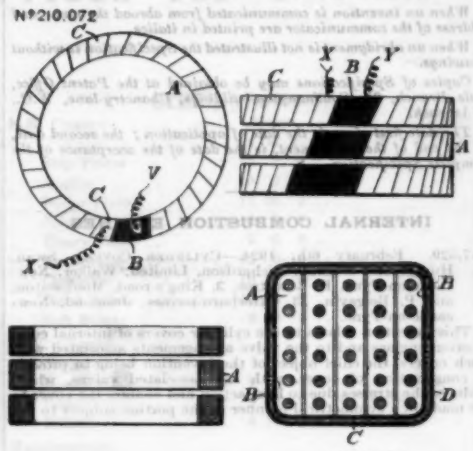


the points. It is pivoted at B, and the opposite end is formed as a hollow cam C. The cam is engaged by a roller D fixed to the wheel E, round which the wire ropes are lapped. The ends of the wires are fixed in the fitting F, which is held in a recess in the wheel E by the tension of the wires themselves. If either wire breaks, the tension in the other one drags the fitting F out of the recess in the wheel, and it jams against one or the other of the catches G G.—*June 19th*, 1924.

MISCELLANEOUS.

210,072. January 16th, 1924.—IMPROVEMENTS RELATING TO PROTECTIVE ARRANGEMENTS FOR HIGH-TENSION ELECTRICAL APPARATUS, Emil Haefely et Cie, A.G., of 353, Lehenmattweg, Basle, Switzerland.

This invention relates to high-tension electrical apparatus, and has for its object to provide improved arrangements for protecting apparatus of this character from the abnormal electrical stresses imposed upon the leading inturns of the windings when the apparatus is first connected in circuit. The coils A, which are provided with a layer of insulating material B, are surrounded by a conducting covering C. This covering C does not extend over the entire length of the coil. It is conductively connected to the supplying lead X of the coil, one end of which is connected to the covering, whilst the other coil end, connected to the outgoing lead Y, is electrically separated from the covering by a strip or gap of insulating material extending over some length of the coil. The covering C is, in turn, protected with insulation D. The insulation strip, which is between the commencement and the end of the covering C, is shown in black. This insulation strip in the successive coil is of different lengths. In order to prevent discharges at the extreme edges of the covering where the outgoing lead Y, coming from the coil, passes through the insulation, the neighbouring edges or ends of the covering may be protected by means of a conducting



varnish or a metal oxide layer, or, in fact, any badly conducting protecting layer, so that an effective shielding of the edge field is secured.—*June 19th*, 1924.

Catalogues.

PARSONS MOTOR COMPANY, Limited, Southampton.—Catalogue of oil and petrol engines.

HENRY BERRY AND CO., Limited, Leeds.—Illustrated catalogue of railway workshop machinery.

SUTCLIFFE BROS. AND BRYCE, Limited, Hyde.—Catalogue of "Crown" coverings for boilers, pipes, &c.

HENRY PELA, 40, Great Marlborough-street, W. 1.—Catalogue of "all steel" scrap and plate shears.

GUMMERS, Limited, Effingham Brass Works, Rotherham.—Pamphlet dealing with modern colliery baths.

MARSHALL, SONS AND CO., Limited, Gainsborough.—Publication No. 1427 on "Marshall" steam road rollers.

HYATT, Limited, 56, Victoria-street, S.W. 1.—Leaflet on "Material Handling at the Lowest Cost per Ton."

A. REYROLLE AND CO., Limited, Hebburn-on-Tyne.—British Empire Exhibition vest pocket memorandum book.

MIDLAND ELECTRIC MANUFACTURING COMPANY, Limited, Birmingham.—Leaflet on the Baby Paragon switches.

POWER PLANT COMPANY, Limited, West Drayton, Middlesex.—New list of double helical gears and their applications.

SUTCLIFFE BROS. AND BRYCE, Limited, Globe Works, Hyde.—Illustrated leaflet on the new Sutcliffe boiler front covers.

WALSALL ELECTRICAL COMPANY, Limited, 67, Bridge-street, Walsall.—Leaflet on switchboards, generator and battery panels.

GOLD COAST RAILWAY, West Africa.—Specially produced illustrated brochure for use at the British Empire Exhibition, 1924.

SWEDISH GENERAL ELECTRIC COMPANY, Limited, 5, Chancery-lane, London, W.C. 2.—Copy of the *A.S.E.A. Journal* for May, 1924.

A. G. MUMFORD, Limited, Culver-street Engineering Works, Colchester.—Section D catalogue of steam and motor-driven pumps.

MANLOVE, ALLIOTT AND CO., Limited, Nottingham.—Booklet 6402, entitled "The Mechanical Equipment of a Modern Hospital."

THOS. BROADBENT AND SONS, Limited, Huddersfield.—Booklet on the "Benn" friction clutch for high or low-speed engagement.

GRAPHITE PRODUCTS, Limited, 218–220, Queen's-road, Battersea, S.W. 8.—Folder setting forth the properties of "Foliac" flake graphite.

UNDERFEED STOKER COMPANY, Limited, Aldwych House, Aldwych, W.C. 2.—Catalogue of the Lopulco system of boiler firing with pulverised fuel.

BEECHCROFT AND PARTNERS, Limited, St. Peter's Close, Sheffield.—Pamphlet entitled "Technical Topics" on testing and analysis of materials.

DAVID WESTON AND CO., Limited, 46, High-street, Croydon.—Pamphlet No. 1 on "The King's Highway," or the economy of concrete road construction.

ANDERSON-GRICE COMPANY, Limited, Taymouth Engineering Works, Carnoustie, Scotland.—Pamphlet on "Anderson" electric overhead travelling cranes.

MONITOR PATENT SAFETY DEVICES, Wallsend-on-Tyne.—Reference cards on the application of Monitor valves, oil pressure alarms and other safety devices.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, Limited, 82, York-road, King's Cross, N. 1.—Catalogue Section S7 of power-operated signals and train stops.

WESTINGHOUSE MORSE CHAIN COMPANY, Limited, Letchworth, Herts.—Catalogue W.M. 124 (Part I. and II.) of the Westinghouse Morse rocker joint chain drives.

MARCONI WIRELESS TELEGRAPH COMPANY, Limited, Marconi House, Strand, W.C. 2.—Pamphlet entitled "Wireless Marconi," a description of the wireless telegraph service.

GEO. KENT, Limited, 199, High Holborn, W.C. 1.—Publication No. 646, being the waterworks section treating of the Kent venturi meter, its types and applications.

J. I. THORNYCROFT AND CO., Limited, Thornycroft House, S.W. 1.—Photogravure pamphlets, Thornycroft motor boats and marine engines and Thornycroft motor vehicles.

SIEMENS BROS. AND CO., Limited, Woolwich, S.E. 18.—Pamphlet 500A, "List of Public and Private Automatic Exchanges." Catalogue 640 on dry cells and batteries.

BELL'S UNITED ASBESTOS COMPANY, Limited, Southwark-street, S.E. 1.—Catalogue of asbestos and engineering supplies. The volume of over 400 pages is divided into twelve sections.

MATHER AND PLATT, Limited, Park Works, Manchester.—A commemorative work on power-house auxiliaries as installed by the firm at Barton power station and other power stations.

ELECTRO FLOW METERS COMPANY, 109, Kingsway, W.C. 2.—Catalogues 1, 2, and 3. (i.) The "Electroflo" meter, an electrical device for measuring the flow of steam, water, gas, air, oil, and all fluids; (ii.) the "Electroflo" boiler meter, an electrical device for measuring boiler load; (iii.) the "Electroflo" draught indicator and recorder.

VICKERS-SPEARING BOILER COMPANY, Limited, 20, Kingsway, W.C. 2.—Catalogue of the Illinois chain-grate stokers for forced and natural draught, also the Illinois flat suspended arch water back.

MACHINE TOOL TRADES ASSOCIATION, 70, Victoria-street, S.W. 1.—An exhaustive catalogue of British machine tools. This catalogue is being reproduced in the French and Spanish languages.

GWYNNES ENGINEERING COMPANY, Limited (Gwynnes Limited), Hammersmith, W. 6.—Catalogue sheets G1 and V1, being specifications of Gwynnes standard "Invincible" centrifugal turbine pressure pumps.

BRUSH ELECTRICAL ENGINEERING COMPANY, Limited, Falcon Works, Loughborough.—The following publications have been specially prepared for distribution at the British Empire Exhibition:—No. 1001, on the Brush-Ljungström turbo-generators; No. 1002, on reducing coal costs with 5000-kilowatt Brush Ljungström plant; No. 1003, on condensing plant and Brush Delas ejectors; No. 2001, on Brush transformers; No. 6000, on alternators for engine and water turbine drive; No. 7000, on frequency changers; and No. 8000, on liquid starters.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF COST AND WORKS ACCOUNTANTS.—Connaught Rooms, Great Queen-street, London, W.C. 2. Costing Conference. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Yorkshire District meeting at Bradford.

SATURDAY, JULY 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Wales District meeting. The Town Hall, Pontypool. 10.30 a.m.

CONTRACTS.

HOLT AND WILLETS, of Cradley Heath, have received an order for nineteen 15-ton overhead travelling cranes from the South Eastern and Chatham Construction and Power Co., Limited, in connection with the Southern Railway electrification.

IT is announced that Sir W. G. Armstrong, Whitworth and Co., Limited, have secured the contract for the construction of a dam, spillway, headworks and power-house and the installation of plant in connection with the New Zealand Government's Arapuni hydro-electric scheme. The cost of the undertaking will be £1,175,652.

MELDRUMS LIMITED, of Timperley, near Manchester, have, during the past three months, received orders for thirty-eight sets of forced draught furnaces and/or mechanical stokers for twenty plants for the disposal of refuse, mainly for the disposal of dangerous refuse, some of them being for the utilisation of heat in boilers or water heaters; for five portable steam disinfectors; for a motor road sweeper-loader; and for several motor car trailers for camping purposes.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

J. W. SHOTTON, marine surveyor, asks us to state that he is moving his office from 32, Mount Stuart-square, Cardiff, to 43, James-street, Cardiff.

ED. BRAND informs us that he has moved his offices and showroom from 96, Victoria-street, Westminster, London, S.W. 1, to 48 and 49, Adam street, New Kent-road, London, S.E. 1. Inland telegrams, Wyrellous Sedist, London; telephone, Hop 6432.

FOUNDRY PLANT AND MACHINERY, Limited, late of 28, Royal Exchange-square, Glasgow, informs us that as from to-day its registered office will be at 100, Wellington-street, Glasgow, Scotland, where all correspondence should be addressed. New telephone number, Central 4950.

DR. LESLIE AITCHISON, D. Met. B.Sc., F.I.C., Consulting Metallurgist of Birmingham, has given up his practice to take up a position as Assistant to Mr. Horace W. Clarke, the Managing Director of James Booth and Co. (1915), Limited, of Argyle-street, Birmingham, which is a firm in the Vickers' group of companies.

W. H. ALLEN SONS AND CO., Limited, of Bedford, inform us that they have appointed Messrs. R. Norman Button and Co., of Central Chambers, High-street, Sheffield, to represent them in that district for the sale of their heavy fuel oil engines. The Sheffield firm will be associated with Messrs. Allen's Manchester office in this connection.

MESSRS. BOSTOCK AND BRAMLEY inform us that the expansion of their business, together with the development of American interests, have necessitated certain changes in their organisation. Captain Bramley-Moore is leaving this country to live in the United States of America, and, in order to effect a closer working with Joshua Buckton and Co., Limited, with whom the firm is in association, the business is being transferred from Netherton to Leeds, the new address being Dewsbury-road, Leeds.

THE vacant principalship of the Northampton Polytechnic Institute, Clerkenwell, caused by the death of Dr. R. Mullineux Walmsley in June, has been filled by the appointment of Mr. S. C. Laws, M.A. (Cantab.), M.Sc. (Lond.), who has been principal of the Wigan Mining and Technical College for the past nine years. The appointment is subject to the approval of the London County Council. Mr. Laws was educated at University College, Nottingham, and St. John's College, Cambridge, where he attended as an 1851 research scholar and was admitted as an advanced student. He worked at Cambridge at the Cavendish Laboratory under Sir. J. J. Thomson and received the special distinction of an extension of his "1851 scholarship" for a third year, the University of Cambridge awarding him the certificate for distinguished research. He was awarded the degree of Master of Science by the University of London for experimental research undertaken while at Blackburn.